EXTENSION OF WATER FACILITIES ACT

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HEARING

BEFORE THE

COMMITTEE ON AGRICULTURE AND FORESTRY UNITED STATES SENATE

EIGHTY-THIRD CONGRESS

SECOND SESSION

ON

S. 3137

A BILL TO MAKE THE PROVISIONS OF THE ACT OF AUGUST 28, 1937, RELATING TO THE CONSERVATION OF WATER RESOURCES IN THE ARID AND SEMIARID AREAS OF THE UNITED STATES, APPLICABLE TO THE ENTIRE UNITED STATES, AND TO INCREASE AND REVISE THE LIMITATION ON AID AVAILABLE UNDER THE PROVISIONS OF THE SAID ACT, AND FOR OTHER PURPOSES

MAY 5, 1954

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CONTENTS

	Page
Statement of—	
Fulbright, Hon. J. W., United States Senator from the State of Arkansas	6
Lynn, John C., legislative director, American Farm Bureau Federation	49
Mansfield, Hon. Mike, United States Senator from the State of Montana	4
McLeaish, Robert B., Administrator, Farmers' Home Administration, United States Department of Agriculture	39
Melton, Marvin W., chairman, Water Resources Development Council in Arkansas, Jonesboro, Ark	35
Smith, Henry C., Deputy Administrator, Farmers' Home Administration, United States Department of Agriculture	42
Miscellaneous documents:	
S. 3137, 83d Congress	1
Message from the Department of Agriculture, requesting enactment of S. 3137	2
Article from Rural Arkansas, February 1954, Irrigation Grows in Arkansas, by James L. Gattis	8
Statement by Kyle Engler, head, agricultural engineering, University of Arkansas, at the Sixth Annual Cotton Mechanization Conference	10
Report by John Kerr Rose, Legislative Reference Service, Library of Congress, on progress and potentialities of irrigation in the nonarid States	12
Articles from the Progressive Farmer, February 1953:	
Why the South Is Turning to Irrigation, by Harold Benford	20
Water Saved Their Crops, by Keith Bilbrey	21
Biggest Yields They Ever Harvested, by Fred J. Hurst	22
Even Lowlands Can Need Irrigation, by G. A. Luno	24
Extra Water—Insurance That Pays Off Every Year, by W. P. Law, Jr., and C. M. Lund	25
Article from the Arkansas Farmer, March 1954, What to Expect in 1954 in Supplemental Irrigation, by James L. Gattis	28
Statement on irrigation in the Arkansas-White-Red River Basins, published by the Arkansas Resources and Development Commission	29
Statement filed by John A. Baker, assistant to the president, National Farmers Union	50
Statement filed by Hon. James O. Eastland, United States Senator from the State of Mississippi	52

EXTENSION OF WATER FACILITIES ACT

WEDNESDAY, MAY 5, 1954

UNITED STATES SENATE,
COMMITTEE ON AGRICULTURE AND FORESTRY,
Washington, D. C.

The committee met, pursuant to notice, at 10:08 a. m. in room 324, Senate Office Building, Senator George D. Aiken (chairman), presiding.

Present: Senators Aiken (chairman), Thye, Schoeppel, and Ellender.

The CHAIRMAN. The committee will come to order.

The hearing this morning is on S. 3137, a bill which would amend the Water Facilities Act of August 28, 1937.

The bill and the message from the Department of Agriculture requesting its enactment will be inserted in the record at this point.

[S. 3137, 83d Cong., 2d sess.]

A BILL To make the provisions of the Act of August 28, 1937, relating to the conservation of water resources in the arid and semiarid areas of the United States, applicable to the entire United States, and to increase and revise the limitation on aid available under the provisions of the said Act, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act to promote conservation in the arid and semiarid areas of the United States by aiding in the development of facilities for water storage and utilization, and for other purposes", approved August 28, 1937 (50 Stat. 869), is amended—

(1) By deleting the phrase "in the arid and semiarid areas of the United States" from the first sentence in the first section;

(2) By deleting the phrase "in the arid and semiarid areas of the United States" in the last sentence of the first section and inserting in lieu thereof the following: "in the United States, including the Territories of Alaska and Hawaii, and Puerto Rico and the Virgin Islands".

(3) By deleting the phrase "in the said areas" wherever it appears in section 2.

(4) By inserting at the end of said Act the following new section:

"SEC. 8. No aid shall be extended under the provisions of this Act which will result in any individual, partnership, trust, estate, or unincorporated association becoming indebted to the United States in a principal amount outstanding at any time in excess of $25,000, or which will result in any corporation or agency becoming indebted in a principal amount outstanding at any time in excess of $250,000, or which after January 1, 1954, shall provide for construction work, other than technical assistance, being done by the Secretary."

SEC. 2. Section 7 of the Act entitled "An Act authorizing construction of water conservation and utilization projects in the Great Plains and arid and semiarid areas of the United States", approved August 11, 1939, as amended (53 Stat. 1418; 54 Stat. 1119, 1124; 63 Stat. 171), is repealed.

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, March 10, 1954.

The PRESIDENT OF THE SENATE,
United States Senate.

DEAR MR. PRESIDENT: There is transmitted herewith a proposed bill for the consideration of the Congress which would amend the provisions of the act of August 28, 1937, as amended, commonly known as the Water Facilities Act, relating to the conservation of soil and water resources in the arid and semiarid areas of the United States by aiding in the development of facilities for water storage and utilization.

Briefly, this bill would effect two changes in the Water Facilities Act. First, it would make the provisions of the act applicable to the entire United States, including the Territories of Alaska and Hawaii, and Puerto Rico and the Virgin Islands, thereby removing its present limited applicability to the arid and semiarid areas of the United States. Second, it would revise the limitation contained in section 7 of the act of August 11, 1939, as amended. Section 7 of that act, as amended, is an amendment of the Water Facilities Act. It limits the amount of Federal financial assistance to any one water facilities project to $100,000 and defines the word "project." The proposed bill would replace that limit on the amount of Federal funds which could be expended on any one project with a limit of $250,000 on the outstanding indebtedness of any corporation or agency by reason of assistance under the act, and a similar limitation of $25,000 with respect to individuals, partnerships, trusts, estates, or unincorporated associations.

The Water Facilities Act authorizes the Secretary of Agriculture to formulate and keep current a program of projects for the construction and maintenance of water facilities and appurtenances to promote the proper utilization of land and to assist in providing facilities for water storage and utilization in the arid and semiarid areas of the United States. This legislation grew out of the facts revealed and the recommendations contained in the report of the President's Great Plains Committee entitled, "The Future of the Great Plains." The scope of the program has been limited to the 17 Western States commonly understood to contain most of the arid and semiarid areas of the country. In these areas, the quantity, quality, and availability of water for irrigation, livestock, and domestic use, rather than a lack of good soil, are frequently the primary limiting factors to agricultural development and stability. The wastage and inadequate development and utilization of water resources on farm, grazing, and forest lands constitute a most significant problem and contribute to the failure of many of our western farms to produce near capacity, to crop failures, and to a decline in standards of living. Although considerable progress has been made in overcoming this problem, much remains to be done to eliminate it completely.

There is ample evidence of an extensive need in the less arid areas of the country for the development and improved use of water supplies for farm homes, for livestock, and for irrigation of small gardens. According to a preliminary report of the 1950 Census of Housing, approximately one-half of the 5,894,000 occupied rural farm dwellings have no running water. This condition undoubtedly exists in many instances because of a lack of developed sources of water or a need for replacing or improving existing sources. Frequently the development or improvement of suitable water supplies is so costly that it cannot be accomplished by farmers from available farm income in any one year. The availability of adequate credit on suitable terms for water development and utilization is one of the important factors in obtaining any desired improvement of this condition.

In areas of the country normally considered humid, there has been an increasing interest by farmers in water facilities to supplement rainfall in the production of some crops, in the maintenance of year-round pastures, and in the introduction of other practices for increasing production. It has been shown that the use of irrigation systems prevents serious losses of income during periods of drought in these areas.

Although water facilities loans are now authorized in the 17 Western States, program operations relating to irrigation actually are limited to designated areas within those States. Before these areas were designated, it was necessary to conduct extensive technical studies into the availability of water resources, the feasibility of developing such resources, the proprietary right to use water, and the adaptability of the soils for the utilization of the water resources and for sound farming operations. If the program should be extended nationwide, we would expect to conduct similar technical studies of areas in the other States. Until this could be done, the scope and rate of development of that phase of the program dealing with irrigation in the less humid areas would be difficult to forecast.

The second proposed change is concerned with the size of water facilities loans. Increase in the cost of materials and construction over the last several years necessitates a further increase in the size of any limit on the amount of financial assistance which may be given under the act.

Moreover, there is a need for loans larger than $100,000 among cooperative water users associations, mutual irrigation companies, and irrigation districts. Usually the members of such organizations are unable to raise their pro rata share of the cost of installations, and the organizations are unable to borrow the amount needed on suitable terms and conditions from commercial banks, cooperative credit sources and other recognized lending institutions. There is now no source of financing the construction or rehabilitation of the systems of such organizations if their needs exceed $100,000.

The limitation on the cost of water facilities projects financed under the Water Facilities Act first appeared in the acts appropriating funds for use under that act. The purpose of the limitation apparently was to avoid any overlapping of activities under the Water Facilities Act and the activities under the reclamation laws. When the Wheeler-Case Act was amended by the act of October 14, 1940, which authorized more intensive development of smaller reclamation, flood control, and power projects, the limitation was enacted into basic legislation. No new projects are now being constructed under the Wheeler-Case Act, due to the fact that the formula for the justification of such projects included the use of WPA and other relief labor, which is not now available.

The present limitation is as follows: "On any one project undertaken pursuant to the act of August 28, 1937, entitled 'An act to promote conservation in the arid and semiarid areas of the United Sgates by aiding in the development of facilities for water storage and utilization, and for other purposes' (50 Stat. 869), as amended and supplemented, expenditures for the construction, maintenance, operation, rehabilitation or financial assistance of any one project, shall not exceed $100,000 of Federal funds, whether appropriated or allotted or both. All project facilities and appurtances which depend for their utility in whole or in part upon each other or upon any common facility shall be deemed one project within the meaning of this section." As heretofore indicated this limitation would be repealed and be replaced by a loan limit of $250,000.

Now that the smaller reclamation undertakings are no longer being developed under the Wheeler-Case Act there exists a gap between the size of the facilities which can be undertaken now under the Water Facilities Act and the projects being developed under the reclamation laws by the Bureau of Reclamation. That gap should be closed. This bill would be a step in that direction. The change would make possible loans for the construction or rehabilitation of needed projects for which Federal assistance is not now available. In addition, the present definition of the word "project" is extremely limiting and difficult of administration when applied to certain types of facilities which, although independently owned and operated, may be related by engineering features or by use of water to another project undertaken with Federal assistance under the Water Facilities Act. The proposed section 8 would, however, terminate the authority of the Secretary to do the construction work on projects. Thus any overlapping of authority between the Bureau of Reclamation and the Department of Agriculture would be avoided. In addition, loans to individuals, partnerships, trusts, estates, or unincorporated associations would be limited to an outstanding principal balance not in excess of $25,000. Loans to this type of borrower are usually for improvements to individual farms or very small projects and it is not believed that loans for these purposes need exceed $25,000 at the present time.

This proposed legislation is consistent with the President's budget message, which states that:

"Existing legislation does not provide adequately for the financing of group water facilities and related small water supply projects. Proposals for legislation will be submitted at a later date to broaden the geographical area within which water facilities loans may be made, and to increase the loan limit."

It is believed that the additional funds necessary to carry out the water facilities program contemplated by this proposed legislation during the first year after its enactment would be $5 million for the making of additional loans and $350,000 for the administrative expenses in connection therewith.

The Department recommends the enactment of this proposed legislation.

The Bureau of the Budget advises that enactment of this proposed legislation would be in accord with the program of the President

Sincerely yours,

TRUE D. MORSE.
Under Secretary.

The CHAIRMAN. Senator Eastland, who is greatly interested in this legislation and has helped sponsor it, was planning to be here, but I understand his plane is grounded and he is therefore unable to be present. He will probably wish to file a statement for the record.

We are glad to have with us this morning Senator Fulbright of Arkansas and Senator Mansfield of Montana.

I understand Senator Mansfield has a very important committee meeting in a few minutes.

Senator MANSFIELD. That is correct, Mr. Chairman.

The CHAIRMAN. I understand that you would like to get there, and if it is all right with Senator Fulbright, we will hear your statement first.

STATEMENT OF HON. MIKE MANSFIELD, A UNITED STATES SENATOR FROM THE STATE OF MONTANA

Senator MANSFIELD. Mr. Chairman, and gentlemen of the committee, 1 am appearing before this committee today in behalf of 3137 because the problem of financing of group water facilities in the Round Butte community near Ronan, Mont., has been pending a long time and only legislation of this kind can help this community.

I introduced S. 1300 dealing with this problem and in addition to the bill now being considered there is a bill S. 1727, introduced by my colleague, Senator Murray, and several bills are being considered in the House. All of these bills deal with the water facilities problem; some provide for more complete revision of the law than others.

The community in western Montana over which I am concerned is blessed with beautiful natural surroundings, good climate, rich soil, sufficient water for irrigation; but there is one drawback, the scarcity of good, pure domestic water. The drilling of individual wells have proved risky and expensive and there are more dry holes than successful wells. The majority of the ranchers haul drinking water in tanks and use ditch or pothole water for washing and livestock.

The community is endeavoring, with the aid of the local Farmers Home Administration, to promote a water users organization to pipe water from some one or two of the existing sources of water, one being a large artesian well about 5 miles from the center of the community. There are over 110 farm homes which would be included in the service and the FHA has estimated the cost of the project at $250,000. Financing such a program with a Federal loan through the FHA under the current program is impossible because the Water Facilities Act of 1937 imposes a limitation of $100,000.

This legislation would alleviate this problem for these farmers and ranchers by increasing the limitation to $250,000 on the amount of Federal expenditures for any one water facilities project constructed or rehabilitated pursuant to the Water Facilities Act.

The bill which I introduced would affect only the groups in the "Great Plains and arid and semiarid areas of the United States." My bill is limited in area, but I understand that the more recent bills apply to the United States and the Territories. I would be in full accord with a decision favoring the bill which is considered to be the most complete in filling the gap which now exists in the area of water facility loans.

The scope of the program as it is now under the Water Facilities Act has been limited to the 17 Western States commonly understood to contain most of the arid and semiarid areas of the country. In these areas the quantity, quality, and availability of water for irrigation, livestock and domestic use, rather than a lack of good soil, are frequently the primary limiting factors to agricultural development and stability. Although considerable progress has been made in overcoming this problem, much remains to be done to eliminate it completely.

There is ample evidence of an extensive need in the less arid areas of the country for the development and improved use of water supplies for farm homes, for livestock, and for irrigation of small gardens. According to a preliminary report of the 1950 Census of Housing, approximately one-half of the 5,894,000 occupied rural farm dwellings have no running water.

This condition undoubtedly exists in many instances because of a lack of developed sources of water or a need for replacing or improving existing sources. Frequently the development of suitable water supplies is so costly that it cannot be accomplished by farmers from available farm income in any one year. The availability of adequate credit on suitable terms for water development and utilization is one of the important factors in obtaining any desired improvement of this condition.

The bills that I have mentioned are concerned with the size of the water facilities loans. Increase in the cost of materials and construction over the last several years necessitates a further increase in the size of any limit on the amount of financial assistance which may be given under the act.

There is a need for loans larger than $100,000 among cooperative water users associations, mutual irrigation companies, and irrigation districts. There is now no source of financing the construction or rehabilitation of the systems of such organizations if their needs exceed $100,000. This limitation would be repealed and replaced by a loan limit of $250,000.

I believe I am correct in saying that this proposed legislation is consistent with the President's budget message which read in part:

> Existing legislation does not provide adequately for the financing of group water facilities and related small water supply projects.

It is my hope that this committee will give a favorable report to a bill which will take care of the problems of water facilities in the Nation which I have discussed with you. I feel that any bill which is reported out of this committee on this matter should contain a provision for increasing the loan limitation and it should be amended to include the entire Nation under the jurisdiction of the act.

The CHAIRMAN. Do you feel, Senator Mansfield, that the particular project near Round Butte which you referred to could be developed within the $250,000 limit?

Senator MANSFIELD. Yes. I have been so informed by the ranchers out there. As a matter of fact, I have inspected the project personally and feel quite certain that that would take care of their problems satisfactorily.

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I would hope, Mr. Chairman, that this program could be extended to the rest of the Nation instead of just to the 17 semiarid and arid Western States.

The CHAIRMAN. Well, I will have to say that there has been no request from anyone to be heard in opposition up to this time. So, the chances look reasonably good that some type of legislation expanding this work both in area and in size might have a good chance.

Are there any other questions of Senator Mansfield?

Senator THYE. I have no questions.

The CHAIRMAN. I did not wait for the full committee to assemble for the simple reason that Senator Mansfield has an important committee meeting at 10:15.

Senator THYE. I was sorry not to have heard your statement, but I was delayed in a conference with some people from home.

Senator MANSFIELD. That is understandable.

The CHAIRMAN. We will now hear from Senator Fulbright, who has long been a champion of water conservation and has for some time in the past expressed a real interest in work of the type which is proposed under this bill.

In fact, Senator Fulbright, I might say that you would undoubtedly have been included as a cosponsor of this bill except for the fact that the bill had already been printed the first I knew of it.

(Discussion off the record.)

The CHAIRMAN. You may proceed with your statement, Senator Fulbright

STATEMENT OF HON. J. W. FULBRIGHT, UNITED STATES SENATOR FROM THE STATE OF ARKANSAS

Senator FULBRIGHT. I appreciate the opportunity to appear before this committee in support of legislation to extend the Water Facilities Act to the rest of the United States. As the committee knows, the act is now applicable only to the so-called arid and semiarid States of the West.

For the record I should like to say that on February 6, 1953, I introduced S. 789, a bill to extend this act to the State of Arkansas. On April 9, 1953, on behalf of myself, Senator Thye and Senator Eastland, I introduced S. 1603, a bill to extend the act to the entire United States.

Anyone from the South and East who has seen the great irrigation projects of the Western States must envy the progress which has been made in converting dry desert land into some of the most productive agricultural areas in the world.

For many years, it has been the policy of the Federal Government to assist this great development by financing projects and rendering technical assistance to individual farmers and groups organized into associations of water users.

The theory of the Congress seems to have been that only the "arid and semiarid" areas of the Western States offered irrigation potentialities, although, in practice, there are irrigation projects in the Western States, built with Federal assistance, where rainfall is as heavy as anywhere in the South.

With the impetus of the disastrous droughts of recent years, farmers, dairymen, and stockmen are interested in irrigation as never before.

New techniques and new equipment have been developed, making irrigation possible where it never was before. Experience has taught us that even in years of normal rainfall—which seem to be getting fewer and fewer—irrigation can be profitable. And in many years it can mean the difference between success and failure.

I believe that irrigation in the South over the next few years will develop as rapidly as rural electrification and farm mechanization have in the past decade.

The passage of legislation to extend the Water Facilities Act will greatly facilitate this development. I understand that the program under the Water Facilities Act, though modest and limited, has been very successful. According to statements made by the Farmers Home Administration before the House Appropriations Committee last year the program has been of great benefit with borrowers making excellent records in the repayment of their loans.

Principal repayments on water facilities loans equaled 99.5 percent of the amount matured as of December 31, 1952. The installation of water facilities through these loans is making a significant contribution in the fuller use of farm resources. This is evidenced by the progress of borrowers who paid their loans in full during the years 1950, 1951, and 1952. Those borrowers who invested an average of $3,163 in irrigation facilities increased their gross farm income, after adjustment for price changes, from $5,968 to $11,717; their net worth from $10,646 to $26,600; milk production, 26 percent; and the yield of small grain, 67 percent per acre. This progress was made in an average period of 4.5 years while these borrowers were indebted for water facilities loans.

Irrigation in Arkansas began in about 1904 and it has progressed to the extent that over 500,000 acres of rice were irrigated in 1953. In the older rice-growing areas in Arkansas the underground water table is falling, necessitating the digging out of deeper wells and the installation of larger pumps, thereby increasing the costs of irrigation. I believe the program under this bill can be beneficial in these areas by providing a source of credit and technical assistance which will enable farmers to construct reservoir systems on their farms to impound rainwater during the winter and spring months, for later use.

However, I believe that it is in the field of supplemental irrigation that the program can be of greatest benefit in the state.

Mr. James L. Gattis, Extension agricultural engineer, wrote an article in Rural Arkansas (a publication of the Arkansas State Electric Cooperative) for February 1954. In this article he analyzes weather data on the frequency of droughts in Arkansas for the 26-year period from 1927 to 1952. The purpose was to determine if droughts were frequent enough and serious enough to justify a farmer's going to the trouble and expense of preparing his farm for irrigation. Droughts were found to occur at 9 selected areas over the State at a frequency of from 63 to 89 times within that 26-year period. Mr. Gattis concludes that the study clearly indicates the need for supplemental irrigation in Arkansas.

Mr. Gattis also concludes that there is no adequate long-term, low-interest credit available to Arkansas farmers for purposes of installing irrigation.

I ask permission of the Chairman to insert Mr. Gattis' article in the record.

The CHAIRMAN. Without objection, that will be included in the record.

Senator FULBRIGHT. It is only a page, I believe. And it is very good information. I may say I think that the conditions in some of my neighboring States are similar enough that these research articles would be interesting to other people involved in this legislation.

The CHAIRMAN. Apparently we have judged the need for irrigation in an area according to the annual rainfall; and apparently it does not matter how heavy the rainfall may be if they have a period of 10 weeks without any rain at all.

Senator FULBRIGHT. That is right. That is the situation in my State. We have very bad droughts in the summer, with very few exceptions.

(The article is as follows:)

[Rural Arkansas, February 1954]

IRRIGATION GROWS IN ARKANSAS

(By James L. Gattis, extension agricultural engineer)

Irrigation is coming to dought-stricken Arkansas. The reports show that 173,727 acres of field crops other than rise were irrigated in 1953 on 2,471 farms. Expansion of supplemental irrigation has been rapid for the past 2 years. In 1952 there were 100,228 acres irrigated on 1,500 farms, but only 28,803 acres on 590 farms in 1951. Another good sign of growth is that some irrigation was done in 66 counties in 1953, as compared to 31 counties in 1951.

To see if droughts were frequent enough and serious enough to justify a farmer going to the trouble and expense of preparing his farm for irrigation, a study was made of climatological data from the Weather Bureau. The chart of results for a period of 26 years certainly indicates the need for supplemental irrigation in Arkansas.

Number of droughts in Arkansas, 1927 to 1952

[Drought duration in days]

Place	20–29	30–39	40–49	50 or more	Total
Fayetteville	47	26	12	3	88
Fort Smith	43	23	11	12	89
Texarkana	36	11	10	9	66
Searcy	42	12	8	5	67
Little Rock	45	17	4	7	73
Hope	37	11	5	11	64
Blytheville	45	19	8	5	77
Pine Bluff	36	13	9	9	67
Helena	32	12	9	10	63

A drought as shown in the above chart was defined as 20 or more days each 10 days of which had a total of less than one-half inch of rainfall.

Cotton being the most important field crop, it is only natural that 67,370 acres of cotton were irrigated in 1953. This crop year more farmers got bigger increases in yield from irrigation than in previous years because the severe drought retarded nonirrigated crops. There were several factors contributing to these yield increases. A better job of irrigating is being done. Portable check dams for head ditches, canal gates, and siphon tubes—along with experience of the farm irrigator are helping get a more uniform distribution of water over the field.

Farmers are learning that during hot, dry weather a 2-inch irrigation will only last 10 to 15 days. Some of the better irrigators have learned that the infiltration rate (or how fast the soil will take water) is a key to successful irrigation. For example, if a soil will take water at the rate of one-half inch per hour, 4 hours are needed to get 2 inches of water into the ground. Where the furrow irrigation method is used a good rule of thumb is to get the water through to the lower end of the row in one-fourth of the total time required to irrigate and then reducing

the flow into the furrow to prevent excess runoff and waste of water at the lower end of the row. To put a 2-inch irrigation on where the infiltration rate was one-half inch per hour, enough water would be put into each furrow to reach the end of the row or irrigation run in 1 hour, then the flow reduced to a trickle to hold water in the furrow for the next 3 hours. When siphon tubes are used, 2 or 3 tubes are recommended for one furrow to get the water through and then 1 tube left to finish the irrigation.

OTHER METHODS USED

Gated pipe is ideal for water control because the flow from each gate can be varied from no flow to about 50 gallons per minute.

With a properly designed sprinkler irrigation system it is a simple matter to get the desired amount of water on by timing each set. A third and important factor is to use the right amount of fertilizer as shown by soil analysis and recommendations of the soils testing laboratory of the University of Arkansas.

Soybeans, a crop of growing importance, were second with 38,000 acres irrigated in 1953. Irrigation of soybeans in 1953 gave a greater percent increase in yield over nonirrigated soybeans than in previous years. The severe drought accounts for part of this, but a better job of irrigation at the right time helped considerably. With acreage control for cotton in 1954, the irrigation of larger acreages of soybeans is anticipated. The problem of getting soybeans up by irrigation in June of 1953 was quite common. The abnormally high temperatures at that time probably were a major factor in inability to irrigate soybeans already planted and get a stand. However, irrigating and then planting as soon as possible afterwards gave good stands in all instances observed or reported.

MANY PASTURES WATERED

Pastures ran a good third with 32,884 acres irrigated in 40 counties. Pastures and meadows are easy to irrigate by either the sprinkler or surface methods. A larger percent of pasture was irrigated by the sprinkler method than any other field crop. Because of the long growing season for pasture crops some pastures will need supplemental irrigation almost every year.

Yield increases due to supplemental irrigation in 1953 have been greater than would be expected over a 10-year average. From the annual reports of county agents, yield increases on irrigated cotton ranged from one-half to one bale per acre, with three-fourths bale per acre increase about an average. Irrigated soybeans ranged from 25 to 50 bushels per acre with doubled yields commonly reported. The actual measured results from pasture irrigation are quite hard to get, but many outstanding demonstrations were reported. Indications are that the carrying capacity was doubled with greater increases in some cases.

Problems encountered were observed, and several farmers having discovered their particular troubles are correcting them this winter An important consideration is an ample quantity of water for the area desired to irrigate. The old rule of thumb of 10 gallons per minute per acre to be irrigated is still good and usually on the safe side. Deciding on whether to irrigate by the surface or the sprinkler method is very important. The best way to decide is to make a topographic map of the farm or that portion to be irrigated and see if the surface method is feasible. Infiltration rates should also be determined along with the predominate soils. Then considering the crops to be irrigated figure or get bids on the initial cost of land preparation and equipment for both surface and sprinkler irrigation. Next consider the operation costs of the surface and sprinkler methods. People who can furnish information on developing supplemental irrigation are the county extension agent, soil conservation technician, irrigation consultant engineers, power use advisers on rural electric co-ops and engineers of irrigation equipment companies.

HARDPAN IS PROBLEM

A problem encountered and particularly noticed during the past 2 years is plow pan or hardpan. These pans often restrict the plant roots to the top few inches of soil. Water goes into the hardpan very slowly and as a result the amount of water stored in the soil is smaller than required by the plant for full production. This leaves the irrigator 1 or 2 alternatives. One is to irrigate more often. The other is to break or eliminate the hardpan so that more water per irrigation can be stored in the plant root zone.

When to irrigate is still a problem to many farmers. There are several instruments on the market for measuring the moisture in the soil. The tensiometer

and the Bouyoucos block are two of the better known devices in this area. Some of the farmers who used the Bouyoucos blocks this year buried the blocks in the fertilizer band and as a result the readings showed that the soil did not need moisture after a month or more of hot, dry weather. The reason for the erroneous readings is that the wire electrodes in the blocks are to measure the electrical current carried through the block. Moisture influences the amount of current carried, but so does the material in the fertilizer. Until a better method is found the "feel test" is recommended. The feel test is made by digging down into the root zone of the plant, usually 6 to 8 inches from the surface for field crops in Arkansas, and taking a handful of soil and squeezing it with your hand. If a film of water is left on the ball of soil it is near the field capacity and does not need irrigation. If the soil is crumbly and does not form a ball, it is near the wilting point and should be irrigated immediately. For details of the test, ask the local county agent for the irrigation "feel chart."

A problem of a slightly different nature is financing the initial cost of an irrigation system. At the present time there is no adequate long-term low-interest credit available to Arkansas farmers. This type of credit is available to farmers in the 17 Western States which start at the west boundary of Arkansas. Men who are sincerely interested in the progress of the State of Arkansas want this. Senator J. W. Fulbright introduced such a bill in the Senate during 1953.

SOME LEGISLATION NEEDED

Water rights laws are needed in Arkansas if the irrigation potential is to be developed. Recognizing this a group of farmers and agricultural leaders have formed a committee and elected State Senator Marvin Melton of Jonesboro chairman of the overall group, called the Water Resources Development Council in Arkansas. Two subcommittees were formed with Clarence F. Byrnes, Fort Smith editor, chairman of the committee for reviewing and drafting a proposed water rights bill. The other subcommittee, with H. H. Harvill, of Humphrey, as chairman, is for the advancement of the Pope-Jones Act or similar legislation to Arkansas and other States. Both jobs are important and any of the above-named three men welcome constructive suggestions from interested citizens. The Pope-Jones Act provides for long-term credit to finance irrigation installations as described earlier.

Senator FULBRIGHT. I also ask permission to insert in the record a statement by Kyle Engler, head of the Department of Agricultural Engineering, University of Arkansas, presented to the Cotton Mechanization Conference held in California in October of 1952. This article discloses some of the results of irrigation at various demonstration farms in Arkansas. For example, Dr. Engler states that irrigation has multiplied yields by 3½ times for Kobe lespedeza, 3 times for green beans, 1½ times to 2½ times for cotton, and 3½ times for tomatoes.

Last fall I requested the Library of Congress to prepare a report on the progress and potentialities in the nonarid States. I offer for inclusion in the record the report of the Legislative Reference Service, prepared by Mr. John Kerr Rose and dated January 25, 1954.

I believe the committee would be interested in that. It contains interesting information about the progress of irrigation in these other nonarid States.

The CHAIRMAN. Without objection, these articles you refer to will be included in the record.

(The articles are as follows:)

(Following are statements by participants in the first of two panel discussions at the Sixth Annual Cotton Mechanization Conference, Bakersfield-Shafter-Fresno, Calif., October 22–25, 1952. Panel leader was M. R. Huberty.)

(Kyle Engler, head, agricultural engineering, University of Arkansas, Fayetteville)

Irrigation started in Arkansas in 1904, when the first commercial rice crop was produced. Since that time we have had a rather uniform increase in our rice

production until at the present time over 500,000 acres of rice is grown annually. The practice of rice irrigation in eastern Arkansas developed water supplies and made farmers familiar with the use of water for irrigation. Consequently, our first irrigation of such crops as corn, cotton, soybeans, and pastures for livestock, was practiced in and adjoining our rice producing areas. Some of the best early work on dry crop irrigation was done in central Arkansas as early as 1930, at which time cotton yield increases were considerable and corn yields were as high as 80 bushels per acre.

The depression of the early 1930's discouraged supplemental irrigation of dry crops due to low prices; however, with the favorable markets of 1940 and later years, our farmers started looking for means of producing greater crop yields and supplemental irrigation was again started. Agricultural Extension records for 1946 show that 16,000 acres of dry crops received supplemental irrigation. The year 1947 was a relatively dry year and irrigation of dry crops increased to nearly 40,000 acres. Even in 1950, with 60 inches of rainfall, over 38,000 acres of dry crops were irrigated. The dry summer of 1952 has again revived farmer interest in irrigation of dry crops.

In a study for the Arkansas-White-Red River Basin report on irrigation, it is shown that well over 1 million acres of dry crops in Arkansas could and should be irrigated. The Arkansas Experiment Station is now doing research work on irrigation of dry crops to determine the effect on yields of cotton through the addition of supplemental water by irrigation. Our results, though not conclusive, show favorable cotton yield increases resulting from irrigation.

On various demonstration farms in Arkansas, irrigation has multiplied yield by 3½ times for Kobe lespedeza, 3 times for green beans, 1½ times to 2½ times for cotton, and 3½ times for tomatoes.

Arkansas' experimental work on supplemental irrigation was started in 1949 and several interesting results have been obtained:

1. Rates higher than one-half inch per hour resulted in excessive runoff when 2 inches of water were applied.
2. The application of 2 inches of water resulted in an excellent stand during early drought in 1950.
3. Irrigated cotton had 20 percent fewer bolls in a 10-foot row on August 18; however, the same irrigated cotton had 56 percent more bolls on September 9.
4. Irrigated cotton at the 60 percent available water level had 25 percent more bolls than cotton irrigated at the 30 percent available moisture level.
5. The drought in 1952 resulted in early irrigation of cotton in eastern Arkansas and irrigated experimental plots showed cotton plants of full vigor and at least twice the height of nonirrigated cotton.
6. The use of fertilizer with irrigation showed increases of 14 to 33 percent even in wet years.
7. The largest increase in yields resulting from irrigation and fertilizer occurred at 400-pound- and 800-pound-per-acre rates.
8. Work on fruits and vegetables near Van Buren and Hope resulted in an 86 percent increase in sweetpotatoes and 63 to 93 percent increase in some varieties of string beans.

These favorable crop increases indicate that irrigation will grow rapidly in our State, and farmer interest is shown by annual acreage increases and large attendances at all irrigation demonstrations. Due to an abundance of ground water in the eastern portion of the State it is expected that wells will be used as a water source in the near future; however, the consistent and rapid decline in our water table, in our rice growing areas where heavy and concentrated pumpage has occurred since 1910 indicates that ground water cannot be considered as an inexhaustible source of irrigation water. In fact, in nearly all cases where wells are depended on for concentrated irrigation there is a definite indication that the supply of ground water is inadequate. This fact shows the importance of developing surface water supplies. One of the most interesting developments in Arkansas is the work now being done on the possibility of using our surface water as a means of recharging our ground water reserve. It is planned to use a system of horizontal collectors, as developed in the Ranny system, with the White River as a surface water source to recharge the depleted aquifer in our ricegrowing area. If the recharge program proves successful it will be usable in many area where present ground water supplies are inadequate.

Through the use of irrigation, Arkansas will increase its cotton production or grow its share of cotton on a decreased acreage permitting the development of other farm crops including livestock.

Progress and Potentialities of Irrigation in the Nonarid States

Prepared at the Request of Hon. J. W. Fulbright

(By John Kerr Rose, Senior Specialists Division, January 25, 1954)

I. PROGRESS OF HUMID AREA IRRIGATION

Irrigation has made rapid progress in the so-called humid States. The 1950 census indicated that there were 1,529,290 acres of irrigated farmland in 1949 in the 31 "other" or "nonarid" States. This was of course small by comparison with the 24,868,899 acres of irrigated farmland in the 17 Western States. Also it was small in relation to the total area of the 31 States (about 742 million acres), and to total cropland in those States. But the upward trend of supplemental irrigation is nevertheless a striking one.

TABLE I.—*Comparative irrigated acreage in 1939 and 1949*

Region	Total acres		Percent increase, 1949 over 1939
	1939	1949	
New England	2,846	31,450	1,005.0
Middle Atlantic	17,260	54,616	217.0
East North Central	10,833	36,237	235.0
West North Central	636,881	1,136,018	78.5
South Atlantic	128,037	381,044	197.0
East South Central	891	6,950	680.0
West South Central	1,472,456	4,162,837	182.0
Mountain	9,912,862	11,642,524	17.4
Pacific	5,800,764	8,324,169	43.5
United States total	17,982,764	25,775,845	43.3

Source: U. S. Bureau of the Census, Statistical Abstract of the United States: 1952 (73d edition) Washington, D. C., 1952.

TABLE II.—*Irrigated farmland in the 31 "humid" States of the United States*

[Acres]

	1949	1939		1949	1939
Alabama	367	281	Mississippi	5,086	94
Arkansas [1]	422,107	159,412	Missouri	2,089	960
Connecticut	8,088	520	New Hampshire	622	25
Delaware	404	7	New Jersey	28,117	7,956
Florida [1]	365,421	126,191	New York	19,248	5,948
Georgia	3,161	158	North Carolina	2,083	246
Illinois	1,510	307	Ohio	5,706	4,536
Indiana	5,384	685	Pennsylvania	7,251	3,356
Iowa	1,386	2,258	Rhode Island	1,631	109
Kentucky	485	205	South Carolina	6,408	411
Louisiana [1]	576,775	413,969	Tennessee	1,012	311
Maine	2,299	143	Vermont	303	
Maryland	697	67	Virginia	2,817	687
Massachusetts	18,507	2,049	West Virginia	40	270
Michigan	13,901	2,960	Wisconsin	9,781	2,345
Minnesota	4,235	2,968			

[1] For 3 of the "humid" States information from the special Census of Irrigation enterprises is available as well as the Census of Agriculture information. In general the Census of Irrigation has consistently reported larger acreages under irrigation in those areas where both are taken—i. e. those States where irrigation is most extensive. For the 3 humid States of extensive irrigation a special effort was made to reduce the discrepancy by accepting a figure close to that given by the Irrigation Census.

Source: 1950 Census of Agriculture, vol. II, General Report, table 22, p. 63.

As to the rapid expansion of irrigation in humid areas, the situation as it has developed in particular States is sometimes cited not only to illustrate phenomenal growth but to illustrate the fact that the census information is soon out of date as regards such a rapidly developing use. In 1946 there were 250 systems in Michigan used on about 10,000 acres. Three years later there were nearly 1,000 systems serving over 40,000 acres. According to the census, in 1939 slightly less than 6,000 acres were irrigated in New York State—by 1946 the potato-producing area of Suffolk County, Long Island, alone had more than 10,000 acres irrigated.

Development of irrigation in the humid and subhumid areas was slow until about 1920. Toward the end of the 19th century, the production of rice under irrigation, a crop that requires continuous flooding during the growing season, was begun in southern Louisiana, southeastern Texas, and parts of Arkansas. Some rice crops were irrigated in southeastern United States prior to 1899. Irrigation of orchard fruits and truck crops in humid States was begun about the end of the 19th century.

Improved farm prices associated with World War I and improvements in pumping and sprinkling equipment, increased the interest in irrigation, particularly in New Jersey, New York, Florida, Arkansas, and Louisiana. Operations in the Eastern States were considerably expanded following the drought years of the early 1930's. Cranberries in the Atlantic Seaboard States, potatoes in Michigan and Wisconsin, fruit and truck crops, particularly in the Southeast and near large urban markets, came in for considerable attention. The drought of the 1930's, high farm prices, better marketing facilities and improved irrigation equipment, particularly portable sprinklers, and the greater availability of electricity in rural areas gave further stimulus to irrigation farming. By 1940 298,000 acres were being irrigated in these more humid areas. Fully adequate statistics on acreage irrigated in the Eastern States during the early part of this century are not available. One compilation based on United States Irrigation Census material indicates:

	Acres		*Acres*
1890	85,000	1930	[1] 603,000
1900	246,000	1940	740,000
1910	[1] 408,000	1950	1,517,000
1920	[1] 599,000		

[1] The data for 1910, 1920, and 1930 are not for the 31 Eastern States but for Arkansas and Louisiana alone.

During the period 1940 to 1950 the area of irrigated lands in the more humid parts of the country increased from less than 300,000 to almost 800,000 acres, not including the riceland of Louisiana, Arkansas, and the eastern part of Texas, where some 1,600,000 acres were irrigated in 1950.

Irrigation methods used in humid areas include all of those used in the more arid areas with, however, a different order of importance. Included are those methods commonly called surface, with the water distributed either by furrow or flooding. A subsurface method, either natural or artificial, is much less common, involving generally peat or muck soils. The sprinkler method is very prominent in the humid area. Sprinkler methods fall into four general categories depending on the equipment used: (1) Perforated pipe or hose, (2) fixed nozzle, (3) rotating-head, and (4) fixed head. Sprinkler irrigation has advanced in importance even in some parts of the West (especially in the more humid areas of Oregon and Washington) because of its peculiar usefulness in irrigating land which is too sandy, too uneven in topography or too easily eroded to be effectively irrigated by surface methods, other reasons are that it is better adapted to occasional or infrequent use, that it saves water (as much as 20 percent) and makes somewhat more efficient use of available land, which would, under surface methods, have to be devoted to ditches, etc. It also is peculiarly useful in irrigating small or isolated or irregular tracts.

TABLE III.—*Sprinkler irrigation, 1949*

Region	Total area irrigated (acres)	Irrigated by sprinklers	
		Acres	Percent of total
New England	31,456	18,783	60.0
Middle Atlantic	54,616	42,030	77.0
East North Central	36,237	31,205	86.0
West North Central	1,136,018	18,302	1.6
South Atlantic	381,044	89,777	23.6
East South Central	6,950	1,794	25.9
West South Central	4,162,837	46,323	1.1
Mountain	11,672,524	43,321	.4
Pacific	8,324,169	348,449	4.2
United States total	25,775,845	639,987	2.5

Source: U. S. Bureau of the Census, Statistical Abstract of the United States: 1952 (73d edition), Washington, D. C., 1952.

TABLE IV.—*Land irrigated by the sprinkler method, 1949*

State	Farms reporting	Acres	State	Farms reporting	Acres
Maine	111	2,131	North Carolina	82	1,883
New Hampshire	38	556	South Carolina	53	1,793
Vermont	14	259	Georgia	92	2,249
Massachusetts	483	6,706	Florida	2,084	80,091
Rhode Island	42	1,462	Kentucky	48	346
Connecticut	245	7,669	Tennessee	29	971
New York	732	16,361	Alabama	31	300
New Jersey	811	19,058	Mississippi	13	177
Pennsylvania	240	6,611	Arkansas	40	1,676
Ohio	431	5,134	Louisiana	36	1,067
Indiana	160	5,285	Oklahoma	76	2,072
Illinois	119	1,400	Texas	415	41,508
Michigan	898	11,894	Montana	250	15,520
Wisconsin	275	7,492	Idaho	344	9,995
Minnesota	278	4,097	Wyoming	14	581
Iowa	54	1,149	Colorado	183	8,194
Missouri	121	931	New Mexico	53	1,822
North Dakota	9	318	Arizona	51	4,011
South Dakota	12	391	Utah	48	1,766
Nebraska	153	8,295	Nevada	33	1,435
Kansas	76	3,121	Washington	3,411	67,852
Delaware	10	404	Oregon	4,140	98,769
Maryland	20	568	California	8,152	181,828
District of Columbia	2	13			
Virginia	64	2,762	Total	25,049	639,987
West Virginia	3	14			

In some areas sprinkler irrigation has increased very rapidly since 1950. In Georgia it has been estimated that the acreage so irrigated in 1952 was 60 percent greater than in 1951, a result partly of the severe drought in 1952.[1]

It has not of course been easy to compare the economics of sprinkler irrigation with surface irrigation in the humid area, partly because so little surface irrigation exists in most sections of the humid area.

The Bureau of Reclamation has provided some comparative information on different methods of irrigating the same tract at three points in the West:

TABLE V.—*Comparison of sprinkler and surface irrigation costs*

Sprinkler type	Location	Annual cost per acre			
		Excluding water and interest		Including water and interest	
		Sprinklers	Surface	Sprinklers	Surface
Semiportable revolving	Pacific Northwest	$22.62	$22.22	$38.55	$38.60
Do	Upper Missouri Basin	13.41	15.22	24.75	27.60
Fully portable revolving	Southwest desert	55.70	21.04	63.87	37.69
Semiportable perforated	Pacific Northwest	33.81	29.73	49.72	46.55
Permanent revolving	Southwest desert	42.97	24.24	65.89	44.79

Source: Sprinkler Irrigation, U. S. Department of Interior, Bureau of Reclamation, December 1949, p. 57.

Other aspects of technological development which have favorably affected the progress of irrigation, particularly in sprinkler irrigation, are:

(1) The development of lightweight aluminum pipe strong enough to take fairly high water pressures, yet rather easily moved.

(2) The design of coupling devices which are comparatively easy to manipulate.

(3) Systems which operate at higher pressures, thus enabling more area to be covered quickly.

(4) Improvements in pumps and power sources which make the use of wells more feasible. Also if new wells must be put down, new techniques are available for locating the most likely place.

(5) More than a little has been learned about the efficient design of a system for a particular farm, and about actual techniques of application of water.

[1] Quackenbush, T. H., Growth of Irrigation in Humid Areas, American Fruit Grower (Western Edition), June 1953, pp. 34–35.

II. POTENTIALITIES OF IRRIGATION IN THE HUMID AREAS

It is easy enough to recognize that some such potentialities, even major ones perhaps, do exist. To measure or evaluate them is quite another matter. Estimates and surveys of potential irrigation developments are not available for the eastern part of the United States. However, it is clear enough that it is physically feasible to irrigate large acreages, especially by sprinkler methods, if the water supply is adequate and cost-benefit ratios support the application of additional water.

As to the long-term availability of abundant irrigation water in areas where other uses will be severely competitive we can do little more than guess. The recent Mid-Century Conference on Resources for the Future, held in Washington in early December 1953, touched on irrigation in the humid part of the United States. The revised section III, Water Resources Problems, contains the following statements:

"*Supply in relation to use.*—Put most broadly, it appears that considering the country as a whole, the supply of water in the Southwest (from western Texas to southern California) is generally less than present and foreseeable demands, while east of the Mississippi River, the supply is much more generous. But this generalization must be immediately qualified. In the West, it will be possible to develop considerably more water, but at higher costs, which people may reasonably be expected to pay, considering that such an essential resource as water now costs relatively little. In the East, certain areas, both industrial and agricultural, are now coming into short supply; e. g., dairy areas in Ohio and Indiana; industrial areas in New Jersey. As water demands continue to grow greatly in the East, further stringencies will occur. Air conditioning and supplemental irrigation are two examples of new demands on supplies east of the Mississippi; industrial use generally has also increased greatly there in recent decades. Another most pertinent qualification is that the supply and demand vary greatly from local area to local area, East and West, given the tremendous variations of climate, topography, land use and settlement, and degrees of industrialization. Thus, generalizations, unless critically evaluated, are invalid. However, it was the view that demand for water generally has grown so greatly since 1900, and makes for such complex local and regional situations, that much study, adjustment, and action on water-resource problems is now imperative. It was suggested, particularly, that long-term averages of runoff and rainfa" should be used only after critical evaluation.

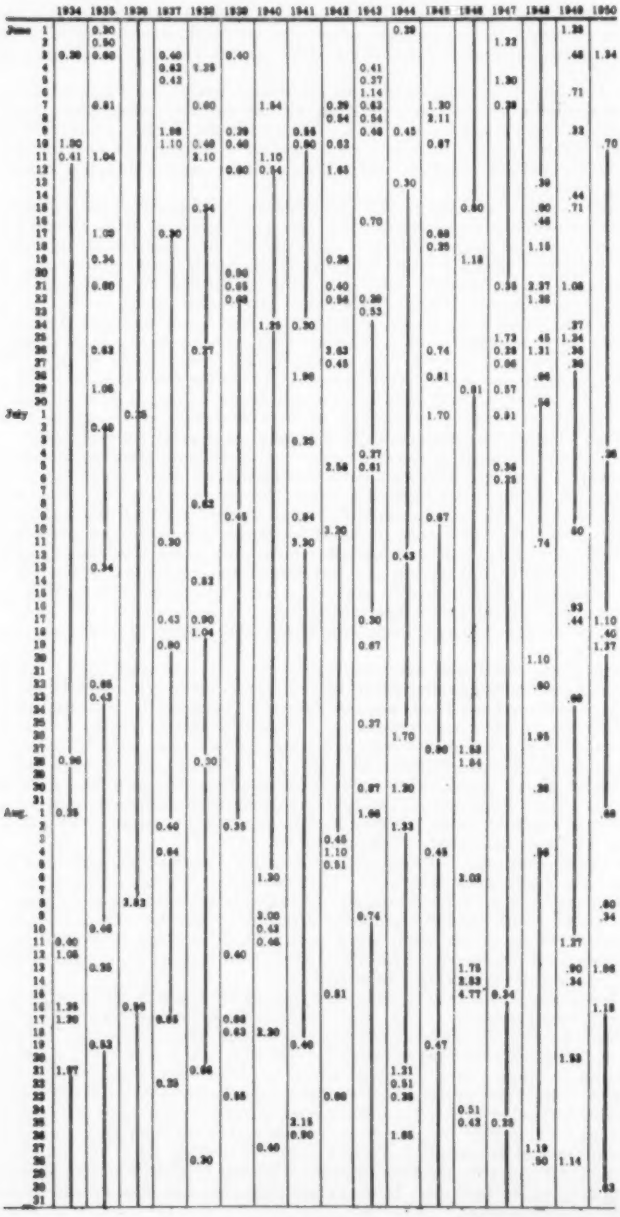
"There was little critical discussion about the extent of water shortages over the country.

"*Increasing demand and emerging new uses.*—It was observed that industrial use of water generally has increased tremendously, although it is difficult at present to estimate and to classify this use satisfactorily, because the information available is fragmentary. *The recent expansion of supplemental irrigation in the East led a speaker to cite a prediction that more water may some day be used for irrigation in the East than in the West.* [Italics added.] It was pointed out that this new use would foster great competition in rural and urban fringe areas, and that water codes in the East should be developed to adjust such increasing demands to local and regional supplies in an orderly and nonwasteful manner. Progress in some Eastern States on this matter was noted."

Of the potential need for supplemental water in crop production in the humid area we have acceptable evidence. Most humid area crops are believe to suffer in most years from insufficient rainfall at critical times during their growth. Not only do shorter and longer periods of drought occur but many rains are largely ineffective. Those of less than one-fourth inch do not penetrate the ground adequately for use by most root systems. Heavy rains of three-fourths inch or more are in considerable degree lost in runoff.

Rainless periods of one or more weeks frequently occur in the humid area during the crop-growing season. (Fig. 1.) In Michigan, during a 10-year period there were on an average 7 periods each year of 1 to 2 weeks' duration in which there was no rainfall. Other States in the humid area show a varying number of such periods per average year: Iowa, 8; Ohio, 5; Wisconsin, Minnesota, Illinois, and Indiana, 6. Rainless periods of 3 or more weeks duration are comparatively rare but a rainless period of 2 to 3 weeks occurs, as an average, once or twice each year. The damage which may be done to crop production by such longer or shorter rainless periods would appear to vary in a complex fashion with the temperature, the crop being grown and its stage of growth, with soil type and management practices and probably other factors. It is certain that damage does result to most crops from most such periods.

FIGURE 1.—*Distribution of rainfall in inches at Jefferson City, Mo., during June, July, and August, from 1934 to 1950, inclusive*


Rainfalls less than 0.25 of an inch are omitted and periods of ten days or longer without effective rainfall are shown by heavy dark lines.
1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950
June
July
Aug.

Source: The University of Missouri Bulletin—Engineering Series, Supplemental Irrigation for Missouri and Regions of Similar Rainfall. Engineering Experiment Station Bulletin No. 33, 1951.

In some of the humid States it appears that as a growing season average about 6 acre-inches of supplemental water by irrigation are required or, put another way, can be used by some crops effectively. One acre-inch equals 3,630 cubic feet or 27,154 gallons. A wet season will require less—possibly little or none. A hot, dry season will require more, particularly on sandy loams.

But whether supplemental irrigation is feasible depends on more than the availability of water and gaps in the precipitation chart.

Effective and profitable irrigation farming in the humid areas is much more than merely applying water when the soil gets dry. It involves the proper use of land, crop rotations, manure legumes, fertilizers, labor and equipment. It is emphasized by most writers on supplemental irrigation that favorable conditions are necessary—favorable as to soil, topography and drainage. In other words there are large sections of humid agricultural area which may be more or disqualified from irrigation by natural conditions. Most of these presumptive disqualifications are partial or related to other factors. But sandy soils and gumbo are among those which should be regarded critically. Topography matters less with sprinkler irrigation than when other methods are used. In much of the humid area it apparently will rarely pay to "level" the land so as to irrigate by other means, such as ditch or by flooding. Even the question of economic size of project in relation to method of supplemental irrigation used, crops grown, labor available and management practices appears to be an important one in relation to potential development of such irrigation. Depending on method used, crops grown, frequency of irrigation necessary, as well as other conditions, ideal project size has been discussed in terms of 80 acres, 160 acres, and 320 acres. But it must be admitted that we know all too little about this as well as other important factors.

In some ways all of this comes to a head in the question of economic feasibility—does it pay? Consideration of the question of whether irrigation will pay depends not only upon probable costs but upon anticipated returns, and these in turn depend in part on the anticipated price levels of future years. So far as costs are concerned western experience with sprinkler irrigation may afford some guidance which is reasonably applicable to more humid areas:

Average annual costs per acre for sprinkler irrigation, Idaho, 1948–49

Item of cost	Free water source	Purchased water source
Depreciation	$6.90	$4.40
Interest on investment	2.60	1.65
Water	0	3.55
Repairs and maintenance	.40	.25
Power	3.75	3.10
Labor	5.30	5.25
Total annual cost	18.95	18.20

Source: Bevan, Roland C., Do Sprinkler Irrigation Systems Pay? The Reclamation Era, October 1953, pp. 161–162. Summarizing Max C. Jensen and Roland C. Bevan, Sprinkler Irrigation on Idaho Farms, Bul. 287, Idaho Experiment Station.

Systems sprinkling 25 acres or less showed an average annual cost of $26.83 per acre whereas those sprinkling 50 or more acres had costs averaging $16.09 per acre. Free water was commonly offset by more expensive installations necessary. Length of life of the system is still an unknown. Power cost was figured at 9 mills per kilowatt-hour. Labor was figured at 75 cents per hour and labor time involved in moving sprinkler pipes average nine-tenths of 1 man-hour per acre per irrigation.

Original costs appear to average $50 to $100 per acre for well-planned projects. Annual cost, whether used or not runs about 7 to 10 percent per year on the original investment, hence $3.50 to $10 per acre. Years in which the system is used will increase this annual cost to $12 to $20 per acre. Much of the total cost of irrigating is for labor and may not require cash outlay. Sprinkling systems to irrigate a given acreage may have an initial cost nearly double that of a surface (ditch) irrigation system for an equal acreage on land of a type well adapted thereto. Pumping for sprinkling will be against higher pressures and power costs will be somewhat greater.

Estimates of the monetary returns which may be credited to supplemental irrigation have been reported within a wide range. Many of such data may be accepted as indicating generally favorable returns for such practices, without too much concern about the complex details of the true comparability of control plots, unirrigated areas and crops compared, etc. Reports are available in greatest number on specialty vegetable crops such as snap beans, turnips, spinach, Irish potatoes, sweetpotatoes, tomatoes, and sweet corn. However, a modest amount of information is accumulating on supplemental irrigation of pastures, field corn, cotton, soybeans, and seed crops of several sorts. It becomes reasonably clear that net returns from supplemental irrigation vary widely not only with market conditions and particular crops, but with the particular season, the degree to which soils are well adapted to irrigation, whether fertilization and planting practices are adjusted thereto, etc.

It appears in essence that such practices, if carried out in the light of the best information now available, are generally profitable, particularly as regards certain specialty crops. One might say that first of all it affords a sort of insurance which permits a stabilization in cropping practice not possible under a strictly natural but uncertain weather regime. The favorable results show up especially strikingly in years of climatic stress, drought, etc. But additionally, the availability of supplemental water appears to give the farmer more elasticity in his operations to permit him to take advantage of off season or early harvest marketing, to permit some "forcing" of plants, to provide the possibility of finishing to higher and more uniform quality. For maximum results, once water is no longer the weak link among the production factors, varieties adapted to higher production, balanced fertilization to support higher yield levels, and even much thicker planting, shallower cultivation, etc., may all be called into play. Farm layout and cropping systems apparently need to be revised on most farms to which irrigation is added.

One report is that irrigation of corn in Henry County, Ind., in 1952 (a drought year), cost about $31 per acre.[2] This comparatively low cost was partly because of rather easy access to water. But at $1.50 per bushel the net profit in favor of irrigation of corn was $105.50 per acre. Yields under irrigation were 127 and 137 bushels per acre as compared with 41 bushels per acre for check fields not irrigated. Heavier plantings and fertilization were of course feasible on the irrigated fields.

A more comprehensive study of irrigation of potatoes and truck crops in Wisconsin and Michigan found that applications of supplemental water plus heavier fertilization generally were profitable though some farmers on some types of soil had not found the increase in yields and quality of product sufficient to justify the additional costs and had ceased to irrigate.[3]

Some of the recent developments have been carried out under competent technological advice and favorable financial circumstances. One of the most interesting reported is the provision of facilities for sprinkler irrigation of 189 acres of pasture as part of a 1,000-acre mountain ranch development by Mr. Winthrop Rockefeller, some 50 miles northwest of Little Rock, Ark.[4] The project, meant to serve as an experimental demonstration one, will involve lifting water nearly 1,000 feet above the Petit Jean River at a rate of as much as 1,320 gallons per minute, should deficient rainfall make such supplemental water necessary or desirable.

With the existing practical limitation on the availability of land with which to expand farm units, except of course at the expense of other existing units, plus the substantial advantages to be gained by utilizing modern machinery and technology to the fullest extent possible, the question arises as to whether it may not pay as well or better to invest additional capital in a farm irrigation system rather than in more land. That is, irrigation provides a new alternative to the previous possibilities of doing a larger volume of business and obtaining a higher net income either by increasing livestock numbers or by buying more land. Thorfinnson [5] found in Nebraska that the farming of an additional 160 acres of unirrigated land at average 1945–50 dry-land yields and prices would give about the same net returns as could be obtained by irrigating one-half of the original 160-acre farm or 80 acres. The irrigation would require 94 days less work per year than the additional land, a difference of $540 in labor income if done with family labor. But capital required for the irrigation system was $5,000 to $8,000 as compared with about $24,000 cost of the additional land. Also, the irrigation

[2] Johnson, George D., "Irrigation—Your Next Big Step to More Corn," Successful Farming, July 1953 Pp. 42–43, et seq.

[3] Irrigation in Wisconsin and Michigan, Economic Information for Wisconsin Farmers, vol. 18, No. 10 October 1947, 4 pp.

[4] New York Times, Dec. 27, 1953, p. 26.

[5] Thorfinnson, T. S., Which Pays Better—To Irrigate or To Buy More Land? The Agricultural Situation, February 1953, pp. 7–8.

would provide a stabilizing effect upon crop production through the years and would provide an improved setting for livestock production which in turn would further increase income.

Another factor now important, but perhaps without much long-term significance respecting irrigation in the humid areas, is the general lack of familiarity with the processes and results. Though comprehensive guidance bulletins are available on various aspects of irrigation farming in the Western States, much less comprehensive and useful information is yet available to the would-be irrigator in the humid area. However, some of the companies supplying materials used in supplemental irrigation have put together useful material with reports from States and some farm case histories of the layout used and results obtained.[6]

Another matter of prime importance to the potentialities is crop adaptability to irrigation. This first of all related to plant types as now developed, that is to genetic characteristics. To some it seems clear that our present plants of the humid area have been selected over the years for ability to produce under more or less restrictive conditions, i. e., ability to survive and produce more abundantly than others under something less than optimum moisture conditions, including occasional drought, etc. Plants best adapted to such occasional relatively trying conditions of the generally humid environment may lack the ability, physiologically speaking, to respond fully to a regular and adequate supply of water.

One of the most important problems affecting the potentialities is the matter of water rights in humid areas. In general the courts of the humid area States have not yet recognized irrigation as a legal riparian use of surface waters. This is particularly important to would-be irrigators of such areas because a majority of farm irrigators use surface waters.

The humid area States accept the riparian doctrine of water use. That is, landowners have riparian rights only when their lands border on the water body. In that case they have certain use rights in such waters, rights to use for domestic and household purposes, for floating logs or boats, for generating power, for swimming, etc. By and large, such water after being used is to be returned to the stream or lake in original volume and state. Liberal interpretation permits industrial and commercial use, and the watering of lawns and gardens, even the irrigation of general crops in some instances.

But there is no provision for acquiring priority in water use or appropriation rights. Riparian owners can't hold back the flow of streams or appropriate or divert surface waters if downstream riparian owners are adversely affected. Nor does the doctrine permit use of such waters for irrigating nonriparian lands.

A minority of humid-area irrigators use water from ground or subsurface sources. About all that can be said about this at present is that farmers have a right to reasonable use of such water so long as their using it does not injure their neighbors.

Two doctrines apply regarding the use of water from wells. Under the common-law rule which still prevails in many Eastern States, the landowner is free to use ground water from his land in almost any manner he chooses. Because of inequities caused by unreasonable withdrawals from common underground supplies, this doctrine has been modified in many States by the rule of reasonable use. Under this rule, owners may be prevented from wasteful or unauthorized practices and under some circumstances may be prevented from pumping more than their equitable share of the water if their action has an adverse effect upon others. But they may still use ground water for a wide variety of uses, including irrigation.

In some States a permit is required from the conservation department, public-service commission, or similar regulatory body for any well that is to produce large amounts of water for irrigation.

All of this becomes important mostly because of the big investment which an individual in most cases must make in irrigation equipment if he is to irrigate any considerable acreage.

It has been suggested that the system of water rights known as "prior appropriation for beneficial use," used successfully in greater or lesser degree by the Western States, be extended to the humid areas. Under that system prior rights prevail. But use, under State or local authority, is of a stipulated amount of water at a given time and place, with use to begin within a reasonable time. To maintain the right it must continue to be used beneficially, in which case the right is permanent. Thus it is claimed that maximum use and conservation of water is encouraged, monopoly is avoided and investment is protected.

South Carolina is reported to have passed in March 1953, a new law which sets up a new water policy and recognizes and protects all existing water rights. Several other Eastern and Southern States are reported to be moving toward more adequate water laws.

[6] See for example, Supplement Irrigation, Johns-Manville Corp., 1951.

Senator FULBRIGHT. On April 9 at the time of introducing S. 1603, I submitted statements for the Congressional Record from the magazine Progressive Farmer for February 1953. These four articles are entitled "Why the South is Turning to Irrigation," "Water Saved Their Crops," "Biggest Yields They Ever Harvested," and "Even Lowlands Can Need Irrigation." I also ask that these may be included in the record.

The CHAIRMAN. Without objection, they will be included in the record.

(The articles are as follows:)

WHY THE SOUTH IS TURNING TO IRRIGATION

(By Harold Benford)

Dry weather in the last few years has shown us the need for supplemental irrigation even in those parts of the South which usually have enough rainfall. Farmers, research workers, and manufacturers of irrigation equipment are proving the value of irrigation and just what methods are needed to make it pay.

All the answers are not in yet, but enough has been done to show the tremendous possibilities. Interest by farmers has increased by leaps and bounds. During the 1952 drought, distributors of irrigation equipment were not prepared to meet demands. Here are typical dollar-and-cents results as we have found them with various crops:

1. Let's begin with cotton. In 1950 about 10 percent of cotton in Texas was irrigated. This irrigated 10 percent produced more than 25 percent of the Texas crop. For example: Ford Bell, of Lubbock County, Tex., who irrigates 330 of his 440 acres of cotton said, "My irrigated crop averages about double my dryland crop. I've averaged a little better than a bale on irrigated cotton. I had some dryland cotton that didn't make nearly a half bale the last 2 years."

2. What about cotton in humid areas? County Agent W. E. Woodall, of Monroe County, Ark., says irrigation has sold itself to cotton farmers in his county. "Many first used irrigation in 1952," he says. "In all cases it paid well. Our highest yield on irrigated cotton was 2½ bales per acre; next, a little over 2 bales. These yields were off good cotton and do not indicate the average. Irrigated cotton in county averaged about 1¼ bales per acre. Nonirrigated cotton averaged only about one-half to two-thirds bale per acre."

3. What about corn? County Agent C. B. Cannon, of Laurens County, S. C., says, "Robert A. Harris in my county, in irrigating 35 acres of bottom-land corn, produced over 100 bushels per acre the last 2 years; last year, 107 bushels. On the other hand, his corn not irrigated was so poor he made it into a low-grade silage."

4. On tobacco, too, irrigation is paying. Take the case of P. G. Cocke, of Pittsylvania County, Va., in 1951: His 4½ acres of irrigated tobacco made 1,942 pounds per acre, which brought 57½ cents a pound. His nonirrigated tobacco made only 1,521 pounds per acre and sold for about 48 cents a pound. He made about $380 an acre more by irrigating, or a total of more than $1,700 on his 4½ acres. His irrigation system cost only $2,200.

5. Next we turn to shade tobacco. Three brothers, Pat, Clyde, and Frank Cantey of Madison County, Fla., who have been irrigating it since 1945 made this report: "Irrigation has upped yields 300 to 400 pounds per acre, and has improved the quality, too."

6. What about vegetables? James Hatcher, of Thomas County, Ga., began irrigating vegetables in the fall of 1951. He irrigated 20 acres of turnip greens and jumped his yield from his usual 2–2½ tons per acre to 4 or 5 tons. He was able to produce and put his crop on market during off season and get a premium price. Last year he irrigated 2 acres of sweet potatoes and produced 519 bushels (376 bushels of No. 1 potatoes brought $3.25; 65 bushels of No. 2's brought $1.25, and 78 bushels of jumbos brought $2 a bushel).

7. Lastly we come to pastures. Pasture irrigation is jumping faster than for any other crop. A typical experience is that of R. W. Kent, dairyman of Shelby County, Ala. He says: "Irrigation saved my pasture during the drought last summer and fall. Drought had reduced my 40 acres of Ladino-orchardgrass-fescue pasture to nothing. It was brown—burned up. Then on August 20 I started irrigating. Clover and grass came out immediately. The 40 acres fur-

nished grazing for 75 milk cows from September 15 through the fall. Irrigation saved us $15 to $18 a day in hay and feed."

Much progress has been made since 1949. Georgia is fairly typical of other States. Willis E. Huston, extension agricultural engineer of Georgia, says that a survey by county agents in 1950 showed 225 farmers irrigating about 5,000 acres. In 1951, this went up to 350 farmers irrigating 9,500 acres. Because of the 1952 drought, irrigation increased 50 to 75 percent over 1951. In Texas, irrigated acreage went to 3,993,896 acres in 1951. It has been estimated nearly another quarter million acres were added in 1952.

How irrigation is growing in Dixie

	1939	1944	1949
	Acres	*Acres*	*Acres*
Texas	843,839	1,358,000	3,430,000
Louisiana [1]	413,969	535,619	1,525,791
Arkansas [1]	159,412	288,665	422,107
Florida [1]	126,191	221,917	365,421
Oklahoma	10,000	18,000	96,000
Virginia	687	1,419	2,817
South Carolina	411	62	6,408
Tennessee	311	393	1,012
Alabama	281	487	367
West Virginia	270	42	40
North Carolina	246	223	2,803
Kentucky [1]	205	240	485
Georgia [1]	158	423	3,161
Mississippi	94	3	5,086
Total for South	1,556,074	2,425,489	5,861,778

[1] Preliminary 1950 releases.

1939 data are from the 1940 Census of Agriculture, First Series.

Source: Census of Agriculture, 1950.

WATER SAVED THEIR CROPS

(By Keith Bilbrey)

The teachings of James L. Gattis, Arkansas extension engineer, hit pay dirt in north Mississippi County in 1952. They paid off for six farmers who tried them. For several years Gattis has been saying, "Supplemental irrigation is practical on many Arkansas farms. It has been needed 2 years out of every 3 in the past."

He helped me hold an irrigation demonstration on the Earl Wildy farm in Mississippi County last May. Fifty farmers attended. The drought was already in progress. Within 3 weeks Mr. Wildy and 5 other farmers had installed irrigation systems.

For the demonstration two irrigation equipment companies cooperated by furnishing their lightweight aluminum pipes, pumps, and sprinklers. Buffalo Ditch, a year-round stream, was Mr. Wildy's source of water. But our demonstration also showed farmers how they could sink four 2-inch pump points and tie them together for a source of water for a 30- to 40-acre irrigation system.

Mr. Wildy bought the system used in the demonstration on his farm, then later in the year bought more equipment. He has a pump capacity of 250 gallons of water per minute and uses 3-inch and 4-inch aluminum pipe.

From May until October, he kept 30 fine Hereford cows and their calves and 50 hogs on 30 acres of irrigated pasture. Twenty acres were fescue and Ladino clover; 10 acres were sweet sudan. The animals remained in excellent shape all summer.

For his pasture, Mr. Wildy used 32 rotary-type sprinklers, each of which effectively covered an area 100 feet in diameter. However, for sufficient overlap, sprinkler heads were placed at 60-foot intervals.

He experimented with furrow irrigation on 20 acres of corn and 7 acres of cotton. His corn yield was tripled.

Mr. Wildy's total investment was $2,000. He plans to irrigate 70 or 80 acres in 1953, if necessary.

Mr. Wildy put ammonium nitrate through his system with ease. A weighed amount of fertilizer was poured into a 5-gallon bucket of water and stirred a little with a paddle. The suction pipe near the pump was tapped with a one-fourth-

inch pipe or nipple. A rubber hose ran from nipple to the bucket of fertilizer. It was drawn out by suction into the system and distributed by the sprinkler heads.

Definite rate-per-acre applications are easy. Figure the acreage each setting is covering. Weigh your fertilizer for that acreage and feed it into the system. It doesn't take long to make the application, then your water is sure to make fertilizer available to the plants.

Virgil and Hershel Johnson bought an aluminum sprinkler system on the spot at the demonstration. The next day they had their system operating from four 2-inch pump points that they installed themselves. The points were driven about 8 feet apart and 19, 25, and 27 feet deep. Then they were piped together, into the horizontal centrifugal pump, and the water was forced out through 860 feet of 3-inch aluminum pipe and rotary-type sprinklers.

During the year the Johnsons watered 10 acres of strawberries 10 times, 9 acres of peaches twice, and 7 acres of cotton twice from these points. They also moved the system to a stream of water and irrigated 9 acres of pasture twice with equal success.

Their strawberries lived while neighboring unirrigated strawberries died.

They sold a record crop of peaches: 1,400 bushels of fine Elbertas from the 9 acres. This yield is nearly three times the State average, and was from 5-year-old trees. There was an unlimited market for the Johnson peaches, because of size and quality, and they regularly sold for 50 cents per bushel more than nonirrigated peaches from the same area.

This pump point source of water increases the possibilities of irrigation tremendously for all this delta area. J. H. Kennett, north of Leachville, bought an Army surplus pump, used an engine off a combine, purchased some old fire hose, sank three 2-inch pump points, and irrigated 6 acres of strawberries—all for $200.

All sprinkler systems used in this area were made of lightweight aluminum pipe. One man can move the system easily and rapidly. Joints couple together with ease and lock together almost automatically. They can be taken apart for moving just as easily.

Some years many of our farmers fail to get a stand of cotton because of dry spells, particularly on tougher soils. Several farmers with annual stand problems are eyeing these new irrigation possibilities with the idea that they could guarantee themselves a stand, at the right time of year, with irrigation. Then, they could irrigate during the summer if and when necessary.

Rates of water application per hour are important in irrigation. They are different for different-type soils, depending upon rate of absorption. This is something that farmers must learn from their county agents or specialists in the field.

Biggest Yields They Ever Harvested

(By Fred J. Hurst)

Throughout the South a searing, parching drought took a tragic toll of crops and pastures in 1952. Oldtimers said it was the driest year they ever saw.

But in Copiah County, Miss., some farmers, with disaster all around them, produced the biggest crop yields they ever harvested. Quality of the crops was tops.

And they revived their pastures during the dry, hot summertime. They seeded fall pastures at the right time, obtained perfect stands, and got a quick growth of clovers and grasses before cold weather came.

The secret was water—irrigation. Water is magic material when it is needed and used at the right time. Water can and sometimes does make the difference between brilliant success or dismal failure.

That's the story, folks. We saw it in Copiah County. R. M. Coman, manager of the Copiah County Cooperative and for many years one of Mississippi's outstanding county agents went with us to see farmers who were irrigating crops and pastures.

On small farms we saw small irrigation outfits that cost as little as $640; on larger farms we saw others that cost as much as $7,500. In each instance the owners declared that if their irrigation equipment and their tractors were taken away from them, they would quit farming.

A. T. Barron, who lives among the steep hills east of Crystal Springs, was one of the first to install a small irrigation outfit. In 1949 he bought a small motor, a 3-inch pump, 400 feet of 2½-inch pipe, and 6 sprinklers.

"All my life I had been trying to raise 10 tons of cabbage per acre," he told us. "This year with irrigation I averaged 14 tons of cabbage per acre."

And Mr. Barron received an average price of $139 per ton for his cabbage—just about $2,000 per acre. The quality of his cabbage was rated excellent. Although he set his plants a little late, they came on fast and he hit the market just right.

But that is not the whole story. He followed cabbage with corn and gathered 80 bushels per acre. No wonder Mr. Barron declared that irrigation is a paying proposition.

He says he found that even in so-called normal years it pays to irrigate some crop at some time during the year. Sometimes only one irrigation is required, but it pays real dividends.

The reason he gets by with such a small outfit is because he has the advantage of a small creek that runs close to his fields.

For Judge W. S. Catchings at Hazlehurst, one of Copiah County's most prominent farmers, it was his first year to try irrigation. But he made 87 bushels of corn per acre by actual weight, no guessing, no estimating. He said that "practically every ear of corn I made was due to irrigation." To obtain this fine yield of corn, he irrigated only once. But it was at exactly the right time, and he really soaked the soil.

On some other corn that was too advanced before he got his equipment, he made 30 bushels per acre. But nearby corn which was not irrigated made a complete failure.

Judge Catchings irrigated his corn in July and saved the crop. Then he moved into his permanent pastures during the hot, dry summer, irrigated them and got fine grazing.

September came and then October, but still no rain to plant his fall pastures. He seeded fescue, red clover, crimson clover, and irrigated. Soon he had a perfect stand. And I wish you could have seen this green pasture of clovers and grasses on December 6. It was enough to tempt any animal.

We agreed that you can save your corn crop, secure good summer grazing, and get perfect fall seeding and quick growth before cold winter weather comes.

T. J. Howard, who also lives in the hills east of Crystal Springs—where they have perennial springs and running streams no matter how dry it gets—irrigated 14 acres of corn, 3 acres of pepper, and 20 acres of pasture. He estimates he made 80 to 100 bushels of corn per acre. He grazed 35 head of cattle on 20 acres of pasture and saved a pepper crop for a neighbor who hired him to custom-irrigate the crop.

He also seeded fall pasture, irrigated, and got a good stand and fine growth. He has a 20-horsepower motor, a 3-inch pump, and 1,000 feet of 3-inch pipe—another comparatively small outfit that is moved easily from one location to another.

Vernon Fairchild, near Hazlehurst, has an outfit big enough to irrigate about 200 acres. He has a 180-horsepower industrial motor, a 6-inch pump, plenty of 6-inch mainline pipe, and 4-inch pipe for lateral lines and sprinklers. We saw this outfit in operation. It does a beautiful job. Each lateral covers an area 80 by 80 feet. He can irrigate 7 to 8 acres at a time and put out 2 inches of water in 4 hours. He had wonderful pasture of fescue and oats, fescue and clover.

Kaywood Plantation west of Hazlehurst is irrigating 200 acres of pasture. The outfit included 180-horsepower motor, 6-inch pump, 1,520 feet of 6-inch pipe, 2,560 feet of 4-inch pipe, and sprinklers. R. S. Glenn, manager, told us that on one 40-acre tract of good bottom land pasture that was well seeded to clovers and grasses and heavily fertilized, they grazed from 1 to 2 animals per acre and cut 2,700 bales of hay.

He obtained excellent stands of fall-seeded pasture by irrigating immediately after seeding and then gave two additional waterings at 10 day intervals. This gave a good growth before cold weather.

Where ryegrass had been drilled in heavy sod pasture and irrigated immediately, there was a perfect stand of grass and good growth.

There are 29 farmers in Copiah County who have installed irrigation outfits, Mr. Coman told us. Most of the farmers financed the purchase of their motors and equipment through the Jackson Production Credit Association.

In most of the small streams the farmers formed temporary brush and dirt dams. This practice provided a larger supply of water than one would think possible.

If irrigation becomes more general, adequate water may become a problem, making it necessary to use all streams, ponds, lakes, and deep wells, in some cases.

EVEN LOWLANDS CAN NEED IRRIGATION

(By G. A. Luno)

There's water aplenty in Franklin Parish, La. Seldom do farmers, other than ricegrowers, have to rig up some sort of apparatus to pump water to perishing plants. Frankly, it is more normal to get standing water away from vegetation, for ours is a swampy land. But there's been a reversal of procedure by some cottonplanters who are upping their yields through the employment of an irrigation system—yes, they're taking the water to the cotton. Why? Because, over a 20-year period, cottongrowers average seven periods, out of 12 months, of 2 weeks or longer with no rain.

Some farmers wanted to be shown irrigation in action. So a demonstration was given on the farm of Liege Braswell, where hundreds of incredulous onlookers saw a panorama of modern agricultural engineering history unfold right before their eyes. With the lattice-gated pipes, the filled canals, and the centrifugal pumps, the Braswell Plantation resembled some industrial center where a more finished produce than cotton was being manufactured.

Among irrigation points demonstrated were concentric rings for measuring soil absorption, use of siphons for carrying water over the banks of canals into individual rows, gated pipes, canvas hose, and the sprinkler irrigation system.

Mr. Braswell has been irrigating his cotton for the past 3 years. He started out in 1949 with about 50 acres, and was so well satisfied with results that he decided to enlarge his operation. His methods were rather crude and required much labor. He dug three small wells, himself, for a water supply. Then right down the center of his field, he dug a large storage canal that ran parallel to the cotton rows. From there he was able to channel the water across the rows and to flush-irrigate. Later he bought some gated pipe. He has been increasing his planting operations consistently, until he is irrigating about 125 acres at the present time.

In 1949 he made a little over 2 bales to the acre. In 1950, his yield was again slightly better than 2 bales to the acre, but last year it was slightly less. This was due to his enlarging the acreage and not having adequate water to take care of additional plants.

Before irrigation, yield averaged three-fourths bale per acre; since irrigation, the 4-year average is about 1¾ bales per acre—an increase of 1 bale per acre. About twice as much fertilizer is being used on irrigated land as is normally recommended for nonirrigated land. Mr. Braswell spent $19 per acre for fertilizer last year.

"Something odd about this system is the fact that he is pumping from wells and using centrifugal pumps," says Mansel Mayeux, Louisiana extension engineer. The conventional pump for a well is a turbine, because it has a high lift. In the Braswell wells, however, a pit has been dug and the motors have been sunk down about 10 feet. In this way Mr. Braswell is able to use the centrifugal pump. It very seldom will lift water more than 22 feet, and shouldn't be operated over 15 feet for good results."

The gated pipe that Mr. Braswell is using is about as up to date as you will find on any farm. Gates on pipes can be opened and closed for regulation. They are spaced same distance apart as rows. Each gate feeds water into an individual row. When water is started, gates are opened wide in order to let water run down to end of furrow as quickly as possible. When water reaches far end of furrow, gate is closed so only a small amount of water continues to trickle down furrow.

Amount of water that will continue to trickle depends upon absorption rate of soil. If soil will take up one-half inch of water per hour, water should be fed into these rows at the rate of one-half inch per hour. If fed faster than that, it will run off at end of row.

There is wide interest among Franklin Parish cotton growers in obtaining irrigation equipment. The time is not too far in the future when cotton irrigation will be a regular practice, rather than the oddity it is tody

Senator FULBRIGHT. An additional article from this issue of February 1953 was entitled "Extra Water—Insurance That Pays Off Every Year." I also offer that for the record.

The CHAIRMAN. It will be included in the record.

(The article is as follows:)

[The Progressive Farmer, February 1953]

Extra Water—Insurance That Pays Off Every Year

(By W. P. Law, Jr., and C. M. Lund, agricultural engineers, Clemson, S. C.)

Extremely dry weather dogged the southern farmer's footsteps in 1952 from spring until far into the fall. All our row crops, corn, cotton, tobacco, peanuts, and vegetables were hurt by drought. Summer pastures were hit severely. Many pastures failed to make growth farmers were counting on using this winter. Many new seedings suffered severely, and many failed. On the other hand, a few of our farmers who had irrigation systems fared well.

Now is a good time to give irrigation another serious thought. Last year was a little drier than usual, but we cannot remember a single year when at one time or another we did not wish for rain.

Many farmers whose crops suffered last year had water flowing to waste on or near their farms, or had water waiting to be tapped just a few feet below their parching crops. Before buying an irrigation system, here are points to consider:

1. Where does irrigation fit and what system shall I use?

Irrigation does not fit into every farm set-up. A farmer with a dependable and easy-to-get source of water has his toughest problem licked before he starts, and can call himself a lucky man. Other problems—management, labor, investment, soil fertility, and per acre value of crops—are problems which certainly must be considered, but do not often make irrigation impractical. In general, irrigation fits any farm where there are valuable crops, a good farmer, and a good water supply.

The flooding of furrows, basins, or borders is widely practiced only where large quantities of water are applied and where land leveling is possible. These are common in the southwest and in rice areas of Arkansas, Louisiana, and Texas. Rather small quantities of water are applied to supplement rainfall in the Southeast. Most soils are too shallow and rolling to allow grading. There are scattered situations where flooding is practiced, but over most of the southeast practically all systems being installed are sprinklers.

2. Water supply demands careful consideration

"If I've got to wait on wet weather before I can irrigate, I'd just as soon not bother with it." Henley McCutchen expressed himself this way, and then tested his "well" for dry-weather yields before he bought any equipment.

If water is limited, then match your system to your water supply. To have more system than water often runs investment per irrigated acre out of reason. You can figure for yourself what a given source of water will irrigate. It takes roughly 30,000 gallons of water to put an inch on an acre.

For instance: You plan to pump directly from a stream that was measured in dry weather and found to be flowing 100 gallons per minute. You figure you will pump 50 hours per week. With very little arithmetic, you see that you can pump 300,000 gallons per week, and can put an inch of water on 10 acres in a week—or 2 inches on 10 acres every 2 weeks.

Or consider a 1-acre pond 10 feet deep at the deepest point, and with no dry-weather inflow. The average depth of this pond would probably be about 3½ feet, say 40 inches. Obviously there are 40 acre-inches of water in the pond. (It is not necessary to convert to gallons.) If you were willing to pump your pond completely dry and had no seepage or evaporation, then you could give a 1-inch "shot" to 40 acres. Of course, this is not a practical answer, because you will have evaporation and seepage. And you may want to leave a third of the water for fish. This means you can only use about 20 acre-inches. Also, 1 inch of water usually will not carry your crop through a drought. Sometimes each acre will need several inches, so 4 or 5 acres now appears to be about the irrigating capacity of the pond.

To be sure of your water supply you will need some technical help. At the end of this article are listed several sources of technical help available to farmers.

3. How big a pump is needed?

Your pump must deliver the water needed to your field at the required pressure. A pump that is a little bit too small or that develops too low a pressure may sometimes be made to do the job by applying more power. But this is poor economy, because the pump loses efficiency and your overloaded power unit may be damaged. Too large a pump is also inefficient, but is preferable to one too small.

You can estimate your pump needs, but selection should be made by an engineer. Let's use an example: You plan to irrigate 20 acres with sprinklers operating at a pressure of 50 pounds per square inch (p. s. i.). You want to apply 1½ inches in 90 hours of pumping. Your field is 25 feet above the water source. (Since 2.3 feet of elevation is equal to 1 pound per square inch, 25 feet is about 10 pounds per square inch.) Figuring pressure drop due to friction in the pipe is another job for an engineer, but assume that it is held to 15 pounds per square inch by using large enough pipe. Now by adding sprinkler pressure (50 pounds per square inch), elevation (10 pounds per square inch), and pipe friction (15 pounds per square inch), you see that your pump must have a discharge pressure of 75 pounds per square inch when pumping the required flow of water.

Your required flow of water is 20 acres times 1½ inches, or 30 acre-inches per 90 hours. This is ⅓ of an acre-inch per hour, or 150 gallons per minute. (A handy fact to remember is that 450 gallons per minute is the same as 1 acre-inch per hour.) So, a pump must be selected that will pump 150 gallons per minute at 75 pounds per square inch. Whatever size your system should be must be determined by a thorough study of your local needs, if it is to give you good and efficient service.

4. What power unit shall I use?

Before selecting a power unit, let's estimate your power requirements. By multiplying 75 pounds per square inch by 150 gallons per minute and then dividing by 1,000 we get 11¼ horsepower. This allows 58 percent for pump efficiency, which is about right for the average farm pump.

An electric motor is by far the most convenient and often the most economical power unit, but in this case 3-phase power would be needed. (The limit on single-phase lines is usually 7½ horsepower.) If a gasoline engine or tractor is to be used, its rated horsepower should be about one-third greater than the load, or, in this case, about 15 to 18 horsepower. Pulling a pump is a man-sized job, and there are no idling periods when the engine can cool off. Many good engines have been needlessly ruined in one season because of overloading.

Tractors are very satisfactory power if they can be spared from other farm work and are not overloaded. They are popular among farmers starting to irrigate, as their use reduces first cost for a system. Low belt speeds and belt slippage sometimes give trouble. Be sure you get proper size pulleys and get your rig properly set. Mounting pump on the tractor, usually up front, ahead of radiator, is easy and handy. Driving pumps from the power takeoff is not usually practical because of low power takeoff speed.

Most farmers who have been irrigating several years prefer complete, self-powered pumping units. They cost more, but they eliminate a lot of troubles.

5. Size of pipe is very important

Excessive friction loss in suction lines and irrigating pipe is probably the most serious error made in system design. A pump, no matter how large, can pump only as much water as atmospheric pressure pushes into it. This means that suction hoses should be as short as possible and one size larger than the suction connection on pump.

Special tables are needed to compute pipe friction. This is another job for an engineer. In the system we have just designed we could use 4-inch main up to 1,000 feet and 3-inch laterals up to 500 feet without running over the 15 pounds per square inch pipe pressure we allowed.

6. What sprinkler should I use?

Perforated pipe or small, medium, or large rotating sprinklers may be used. Whichever is used, correct pressure must be supplied to get satisfactory operation. Perforated pipe is usually operated at 10 to 20 pounds' pressure and covers a strip 20 to 40 feet wide and as long as the pipe. It is satisfactory on open soils and sods where water may be applied rapidly.

Rotating sprinklers are very popular because they fit a wider variety of conditions. They operate at a pressure between 20 and 120 pounds per square inch and discharge from 5 to 500 gallons per minute, covering from one-fortieth of an acre to 4 acres each. The small sprinklers, with lower pressures, save on power and first cost of system, but require more frequent moving than larger sprinklers. They are also usually easier on the soil, because proper operating pressure is more easily supplied. Insufficient pressure results in very large drops of water which pack and puddle soil surface.

The 50-pound pressure we selected in our problem means that we can use sprinklers discharging 10 to 25 gallons per minute each. So let's select one that will discharge 15 gallons per minute at 50 pounds per square inch; then 10 of these will take care of our pump capacity of 150 gallons per minute (or, if 15 sprinklers fit our field better, we could use 15 10 gallons per minute sprinklers).

7. How much will system cost?

The system we have figured on will probably cost around $1,600. Let's itemize it, showing costs in round figures. This may vary some in different areas, but should be close.

3-inch by 2½-inch pump, with belt and priming device	$175
4-inch by 20-foot aluminum suction pipe, with elbow and strainer	50
1,000 feet—4-inch aluminum portable pipe	950
500 feet—3-inch aluminum portable pipe	350
Elbow, cap, and risers	25
10 rotating sprinklers	60
Total	1,610

This is about $80 per acre, which is typical for this size system without its own power unit. Small systems may run twice this much per acre, and large systems half this much. The most effective way to reduce per acre cost of a system is to pump more hours per week. This way, more acres can be irrigated with the same system. Distance water must be pumped also is very important. Note the cost of 4-inch main is over half total cost. A source of water nearer field would save a great deal in first cost and pumping costs.

8. What is life of system?

Aside from engine and sprinklers, there is little to wear out about an irrigation system. Sprinklers used only for supplemental irrigation, should last about 5 years. Rubber suction and discharge hoses may last only 5 or 6 years if left exposed, but aluminum pipe used in place of rubber should last at least 20 years, as will properly cared-for portable pipe. A good pump should also last 20 years if properly serviced.

Using these figures to compute annual overhead cost of our system we get about $88. Adding 5 percent for interest and 1 percent for repairs makes a total annual overhead of $185. So about $9 ($185 divided by 20 acres) per acre would be our annual cost of the system.

Operating costs (fuel and labor) generally run about $2 per acre-inch of water applied. To get water to his peach orchard, Dave White of McBee, S. C., pumps it farther (5,500 feet) and higher (155 feet) than anyone we know. He says his operating cost is about $3 per acre-inch.

9. You can get help in planning

Your three principal sources of technical irrigation assistance are your extension service, your soil-conservation district, and irrigation equipment salesman in your area. In most States, county agents can call in an engineer from the college, and soil conservation work units can call on their regional office for assistance. Many dealers are good designers, though their business is selling, not designing; and some companies provide their dealers with engineering services. Your State college probably maintains a list of dealers.

If system fits your needs, you will be happy with it. We have yet to find a farmer who is not.

Senator FULBRIGHT. I also ask that there be inserted in the record another article by Mr. James L. Gattis which appeared in the Arkansas Farmer for March 1954. I also offer for inclusion in the record a statement on irrigation in Arkansas furnished me by the Arkansas Resources and Development Commission and prepared in connection with studies by the Arkansas-White-Red River Basins Interagency Committee.

The CHAIRMAN. They will be included in the record.

(The articles referred to above are as follows:)

[The Arkansas Farmer, March 1954]

What to Expect in 1954 in Supplemental Irrigation

(By James L. Gattis, extension agricultural engineer)

After the serious droughts of 1952 and 1953, many farmers are asking about supplemental irrigation. This is only natural after having seen or heard of some of the crop yields of other farmers. Result demonstrations in supplemental irrigation were conducted in 66 of the 75 counties on field crops, according to reports of the county extension agents. In several counties supplemental irrigation has advanced past the demonstration stage. Reports show that 2,471 farmers irrigated 173,727 acres. The number of acres irrigated per farmer varied from a few acres to over 200 acres, with an average of 70 acres per farmer.

As might be expected, the largest single crop other than rice was 67,370 acres of cotton irrigated. The largest irrigated acreage was that in the Jefferson and Lonoke County area. In 1953 just over 3 percent of the cotton grown in Arkansas was irrigated. With cotton acreage control for 1954 there will be fewer acres grown but emphasis will be on high yields per acre. Since the Cotton Branch Experiment Station at Marianna reported a 68-percent increase from irrigation in 1952 and made similar gains in 1953, there undoubtedly will be more acres of cotton irrigated in Arkansas in 1954. I wouldn't be surprised to see 10 percent of the cotton irrigated in 1954. Inadequate credit could be a limiting factor unless more long-term loans can be obtained.

A few points to keep in mind when planning to irrigate are that it takes air, sunlight, and fertilizer, as well as water to produce a good crop. Unless you do something about it, sunlight is the onlyone of the four likely to be there when needed. Good drainage is important for proper aeration of the soil. A poorly drained soil may become waterlogged and warm up late in the spring. Such a condition makes getting a good stand difficult. To insure the proper plant food see the county agent for information on how to get soil tests made at the soils testing laboratory operated by the University of Arkansas. These tests will show the amount of the different plant foods needed on each field. A proper balance of fertilizer for irrigated crops is just good business. Getting 2 bales of cotton per acre even with irrigation required good management as well as a good job of irrigating. In this State an irrigation schedule doesn't seem to work very well because of rainfall, temperature, wind velocity and humidity variables which differ from year to year.

Cotton will probably need irrigation from 1 to 5 times, depending upon the weather, the soil texture and available water storage capacity. During the past 25-year period, 1927 to 1951, cotton needed about 50 irrigations or an average of 2 per year (based on the drought chart published by the Arkansas Agricultural Extension Service).

Result demonstrations on irrigation will be set up again this year in most of the counties. These demonstrations will be on the major field crops, pasture, vegetable, and fruit crops. Such demonstrations are usually set up when a farmer in a county becomes interested and contacts the county agent. After talking over the practice, and if there appear to be good possibilities, the agent may suggest such a demonstration. Then the county agent will make a point to stop by and look at the source of water, the soil, and general lay of the land. If the personal visit indicates a feasible demonstration the county agent then has available the help of specialists needed in developing such a demonstration. For an irrigation demonstration the engineer and soils specialists are usually called. However, it is not uncommon for the agent to get help from several other specialists on the irrigation demonstration—usually when they are in the county on other work. Agronomists, horticulturists, entomologists, plant pathologists, farm management, and other specialists are available.

VISITING FARMERS ATTEND

At the proper time to show the results of the demonstration the agent may arrange for a visit or field day when farmers from other parts of the county will be invited to come and see the results for themselves. This is just one of several ways the county agents get new proven practices adopted by famrers. Pictures may be taken at different stages of the demonstration and then used in a series for a group meeting held at different places in the county. In addition to those mentioned, another slightly different type of demonstration may be given, called a method demonstration. At these, some of the different methods which are

recommended for irrigation are actually demonstrated in the field. These were available to farmers in about half of the State in 1953.

The county agent has the educational responsibility for introducing new agricultural practices in the field. However, he is limited in the number of demonstrations with which he can personally help. So volunteer farm leaders help pass the information on to their neighbors. For technical help such as engineering work needed in planning irrigation systems, the farmer is referred to the Soil Conservation Service, a firm of consultant engineers, or an irrigation equipment company, most of whom have trained engineers available.

NOTE.—The attached statement on irrigation was prepared by a group of agriculturists and engineers in connection with studies currently in progress by the Arkansas-White-Red Basins Interagency Committee. This study was authorized by the 1950 Flood Control Act. The group of men who prepared this report is perhaps the best informed group within the State on the subject of irrigation. Throughout the narrative section of the report it will be noted that the references are made to the AWR Basin in Arkansas. This basin embraces all of the State with the exception of the St. Francis Basin in eastern Arkansas. For the purposes of this presentation pertinent available data on the St. Francis Basin has been included in the summary of irrigation needs for the State and the grand total on that summary represents the thinking of the technicians with respect to the entire State.

ARKANSAS RESOURCES AND DEVELOPMENT COMMISSION,
ARTHUR M. EMMERLING, *Director.*

IRRIGATION AWR BASINS IN ARKANSAS—INVENTORY AND STATEMENT OF NEEDS

1. *Introduction.*—Irrigation in Arkansas differs somewhat from that practiced in the arid and semiarid regions of the United States. Irrigation in this report is divided into two major practices: (1) rice irrigation, and (2) irrigation of crops other than rice, referred to in this report as supplemental irrigation. Rice irrigation differs from supplemental irrigation in that the rice crop is grown in standing water ranging from 0.3 to 0.6 foot deep during almost all its growing period. The retention of water at these depths is accomplished by a series of dikes, locally called levees, located on a true contour and spaced at vertical intervals ranging from 0.1 to 0.3 foot depending upon the slope of the land. Supplemental irrigation in the State is designed to insure optimum moisture conditions in the soil during crop-growing periods. At the present time rice irrigation is the more extensive practice but irrigation of other crops is increasing steadily and may become the major user of irrigation water.

2. *History and trend of rice irrigation.*—In Arkansas rice was first produced commercially in 1904. A 70-acre field near Lonoke yielded 70 bushels per acre and the crop sold for $7,000. Favorable conditions of soil, topography and favorable market conditions resulted in a steady increase in acreage. By 1915 there were 100,000 acres; by 1942, 200,000 acres; in 1947, 300,000 acres; and in 1949, 350,000 acres. The only major reduction in acreage occurred following the disastrously low price of $0.38 per bushel in 1932. Acreage control started in 1934 and continued through 1943. During the control period acreage ranged from 130,000 acres in 1935 to 242,000 acres in 1942. Acreage control in 1950 resulted in a crop of 278,000 acres. The Grand Prairie region centers around Stuttgart and produced approximately 80 percent of the State's total rice acreage until 1934. Since that time areas outside the Grand Prairie have expanded until at the present time (1950) well over 50 percent of the rice produced in Arkansas is outside the Grand Prairie region.

3. *History and trend of supplemental irrigation.*—The average rainfall for Arkansas at Little Rock is about 48 inches. Climatological data for the State, however, show extremes in annual rainfall ranging from 24 to 84 inches. These variations in annual rainfall and erratic distribution during the crop-growing season often materially reduce yields. Supplemental irrigation can play a most important part in providing the moisture required to obtain high yields.

4. Since rice irrigation was practiced first, supplemental irrigation in Arkansas started in and adjacent to the area where rice irrigation was practiced. One of the best reports available of early supplemental irrigation work is from Jefferson County. This report accompanied a letter dated August 9, 1930, written by Mr. Ben A. Pearson, manager of the rural electric service department of the Arkansas Power and Light Co. Mr. Pearson gives a report of the Couch Brothers' supple-

mental irrigation project at Noble Lake, Ark. At the time of the report corn had been successfully irrigated. Yields of 50 to 80 bushels per acre were obtained. The furrow method of irrigation was used and about 2 inches of water per acre were applied.

5. The depression of the 1930's discouraged supplemental irrigation since there was an overproduction and the market for farm products was poor. Consequently, during the thirties supplemental irrigation dropped out of the picture in Arkansas. With the advent of World War II, and a favorable market for farm products, farmers began to look for means whereby they could produce greater yields, not only as a patriotic obligation, but to increase their own profit at the same time. Supplemental irrigation was again started.

6. Records of the Soil Conservation Service and Extension Service for the year 1946 show that 16,100 acres of crops were supplementally irrigated in 20 counties of the AWR basins of Arkansas. At the same time there was considerable interest in irrigation of truck crops and farm gardens. During 1947, a relatively dry year, increases in supplemental irrigation were reported showing 39,488 acres irrigated in 31 counties in AWR basins of Arkansas. In 1948, a relatively wet year, reports show 59,748 acres supplementally irrigated in 39 counties, since irrigation was needed during short drought periods. In 1949 only 24,802 acres were irrigated in 32 counties. In 1950, in spite of the fact that there were 60 inches of rainfall during the first 10 months of the year, 38,287 acres were irrigated in 29 counties. In addition, 543 truck patches and 2,139 farm gardens were irrigated.

7. Most of the principal methods of applying water for irrigation are followed in Arkansas. Row crops in the early years were primarily irrigated by the furrow method. For close-growing crops, such as lespedeza, on rice soils, irrigation was accomplished by flooding the top levee of the field, then cut to drain into the next lower levee. This operation continued until the entire field was covered. The sprinkler method has rapidly developed following World War II; even so, there are records of sprinkler systems having been used in Arkansas at least 20 years ago. Improved design in pumps and power units coupled with lightweight portable pipe has resulted in farmer acceptance. Now (1950) about 25 percent of supplemental irrigation in Arkansas is done by the sprinkler system. In the hill sections of the State the sprinkler system is used almost exclusively.

8. Results of irrigation demonstrations by the Extension Service in 1947 and 1948 indicated that crop yields in lespedeza, corn, cotton, soybeans, and tomatoes were increased from 2 to 4 times those of unirrigated plots.

9. *Present inventory.*—The total rice acreage in the AWR basins of Arkansas in 1950 was approximately 278,000 acres. The White River Basin, which includes most of the Grand Prairie region, was the largest producer with nearly 181,000 acres. The Arkansas River Basin which contains the remainder of the Grand Prairie region, was second with about 71,000 acres of rice, while the Red River Basin, a new producer of rice, was third with about 26,000 acres. These figures reflect the acres harvested in these basins in 1950 and are lower than 1949 due to the acreage controls on rice being in effect in 1950. Rotation and other good farming practices followed by the rice farmers of the area require approximately 3 acres of riceland developed for irrigation to produce an acre of rice annually, which means that there are approximately 800,000 acres of land developed for rice irrigation in the AWR basins of the State. Principal crops grown on this land in rotation with rice include oats, lespedeza, soybeans, corn, and cotton.

10. The reports of the Agricultural Extension Service and reports of the Soil Conservation Service were combined, omitting duplications, to determine the number of acres equipped for supplemental irrigation. By taking the greatest number of acres which had been irrigated in each county in any year from 1946 through 1950, inclusive, it was found that there were 87,546 acres which had been supplementally irrigated. Of this amount, 50,162 acres were in the White River Basin, 28,703 were in the Arkansas River Basin, and 8,681 acres in the Red River Basin. There are possibly another 10,000 acres outside the rice area which are equipped but have not been irrigated to date.

11. With proper fertilization and the addition of 2 or 4 irrigations, corn has produced yields well above 100 bushels per acre; cotton has responded well, particularly in the dry years, with increases of one-half bale per acre being common. Soybeans have also shown increases in yields of as much as 45 percent. Meadow crops and pasture crops like alfalfa, clovers, and grasses have also shown good response to supplemental irrigation. For example in the experiments made, lespedeza has shown an average increase of around 300 pounds of seed per acre. The vegetable crops have shown a very marked response to supplemental irriga-

tion. Not only have the yields been tripled or quadrupled, but the quality has also been improved. The present (1950) acreage of irrigated crops is shown by problem areas and basin totals on the attached tables.

12. *Potential development.*—Rice irrigation in Arkansas is best adapted to soils with low permeability rates which hold irrigation waters on the surface for long periods. Also the topography should be smooth and nearly level so that the water can be retained at nearly uniform depth on areas of sufficient size to permit the use of large farming machinery. The major portion of the developed riceland is in areas where more than 50 percent of the total land area is suitable for rice irrigation. These areas occur principally in the eastern and southeastern parts of the basins.

13. The northwestern portion of the State is generally rough in topography and contiguous bodies of land having soils suitable for rice culture are rare. Although a small percent of the land area may be smooth enough and have soils with suitable characteristics it is not anticipated that rice will ever be grown in much of the area. Some small development may be expected immediately above Little Rock near Perryville and Morrilton because of the proximity and easy access to developed ricelands and accompanying drying, storage, and milling facilities.

14. The attached table shows the potential rice acreage of the AWR basins by problem areas along with present rice acreage. Ground water probably will not be available in sufficient quantities and surface water supplies may be difficult to develop in some areas for the entire acreage; consequently the development of rice areas generally will be limited by a combination of (1) soil suitability, (2) available water supply, and (3) demand. The first two factors have been considered in arriving at the probable irrigable annual acres by counties and basins, which is shown in attached table and will limit the irrigable acreage annually in the AWR basins of the State to about 514,000 acres consisting of 96,000 acres in the Arkansas, 274,000 acres in the White, and 144,000 acres in the Red River Basin. The ultimate development, however, will depend upon the factor of demand.

15. Climatological conditions determine the need for supplemental irrigation. Droughts during the crop-growing season can be expected to last from 20 to 50 days nearly every year, with the shorter droughts occurring on the average of more than 1 a year.

16. Supplemental irrigation can be successfully used on any soil having characteristics which will permit the production of high yields of adapted crops if adequate moisture is available. Therefore, supplemental irrigation can be used on a much greater percentage of the total land area of the AWR basins of Arkansas than rice irrigation.

17. Probably supplemental irrigation in the AWR basins of Arkansas is shown in the attached tables. The total for the State is estimated at 3,215,000 acres of which 1,356,860 occur in the White River Basin; 1,126,900 acres in the Red River Basin; and 731,240 in the Arkansas River Basin. The extent of the development of the area will depend to a large extent upon the demand for additional yields.

18. *Water use.*—Approximately 2.6 acre-feet of water is required to produce 1 acre of rice. Of this amount an average of approximately 1.8 acre-feet must be supplied by irrigation facilities while the remainder is supplied by rainfall. This means that rice production in the AWR basins of Arkansas required that approximately 500,000 acre-feet of water be furnished by the established irrigation facilities in 1950. In 1949 a total of 630,000 acre-feet was required while an even greater amount will probably be required during 1951 due to a further increase in rice acreage.

At the present time ground water furnishes a large part of this total. The ground water comes from two sources, tertiary or deep wells and quaternary or shallow wells. Of the two, the shallow wells are much more important, furnishing water for approximately 235,000 acres in 1950 while approximately 2 dozen deep wells are in existence furnishing water for only an estimated 7,500 acres of rice.

19. *Irrigation wells.*—Shallow wells, quarternary, range in depth from 90 to 170 feet depending on their location, and vary in capacity from 500 to 3,000 gallons per minute; and their cost, including power unit and pump, ranges from $4,500 to $7,500 depending on depth, capacity, and power source. The static water level in these wells range from 4 feet to 110 feet again depending on location.

20. Deep wells, tertiary, generally range from 450 to 1,100 feet in depth depending on location, and range in cost from $15,000 to $22,500 depending on depth and size. This cost is a factor against using deep wells as a source of irrigation water.

21. *Ground-water depletion.*—Consistent lowering of the ground water level has occurred in all areas producing rice from concentrated locations. The outstanding example is that found a few miles east of Stuttgart where the ground water level has lowered over 60 feet since 1910. Current rates of decline of ground water level in the Grand Prairie region range from approximately 0.5 to 2.75 feet annually. Since 1929 the observed average rate of water level decline has been between 0.75 and 1 foot per year in a large central portion of the Grand Prairie region. Due to this lowering of ground water level not only have pumping costs been increased but a far more serious situation had resulted due to the fact that the remaining depth of water is so low that it is impossible to develop wells that will produce as much as 500 gallons per minute, which means that a well will not irrigate an economical unit for rice production. The Grand Prairie region is now faced with a problem of either developing an additional water supply or a drastic curtailment of rice irrigation. This has been recognized by the authorization of the Grand Prairie project. Outside the Grand Prairie region some decline of ground water level has been experienced and serious decline is expected to occur if extensive use of ground water develops.

22. The increasing use of ground water shown in expanded areas of the lowering ground water table will naturally result in the expanded use of surface water. Consequently, increased use of surface water through direct pumping from streams, pumping from storage from reservoirs and lakes, and the use of surface water for ground water recharge must follow when irrigation concentrations develop.

23. *Present surface water use.*—Surface water is used to irrigate approximately 36,000 acres of rice in the AWR basins of the State. This water is obtained from stream diversions, lakes, and shallow storage reservoirs. These shallow reservoirs range in size from 20 to 4,200 acres and are primarily individually owned although a few privately owned commercial installations are in operation. This type of commercial installation is exemplified by the Arkansas Irrigation Co. located on LaGrue Bayou in Prairie County. The surface area of this reservoir is approximately 4,200 acres and it has a capacity sufficient to supply water to irrigate approximately 4,000 acres of rice. While a few projects of this type are in operation, by far the greater amount of surface water is obtained from the smaller individually owned reservoirs, the importance of which cannot be overemphasized.

24. *Water rights.*—Arkansas has at the present time no means by which an individual can establish a legal right to the use of water. Experience has shown that in any area where water is used for irrigation some definite water rights policy is necessary if full use of available water is to be made. Also, experience has shown that the riparian doctrine has been difficult to administer and in general has proved an unsatisfactory code. The riparian doctrine permits no use of water for irrigation on lands not riparian, which is in direct conflict with many of our recent practices.

25. The doctrine of appropriation has proved to be applicable for the use of irrigation water. The appropriative right is an exclusive right and depends upon the principle of first in time, first in right, which means the first person to acquire appropriative rights pertaining to a particular source of supply has the prior right relating to it. The streamflow must be permitted to satisfy the first rights before any holder of subsequent rights may divert water under the appropriative doctrine. The right to use water, therefore, is not dependent upon correlative rights of others to the use of water on riparian lands, but only upon a reasonable use. This doctrine ties in with the present policy of users of surface water in Arkansas. The appropriation doctrine, therefore, protects investments made and permits complete development of available water supplies.

26. In States where both the riparian and appropriation doctrines are recognized, serious litigation has arisen over the conflict between these doctrines. The conflict between the right of the riparian landowner, the right of other landowners, and the right of an appropriator to make an exclusive use has presented an almost hopeless situation. In most States this conflict has caused the riparian doctrine to be dropped and the appropriation doctrine to become the water code of that State. Therefore, it seems desirable to develop the appropriation doctrine for ground and surface water before the two doctrines come in serious conflict.

27. It is believed that the appropriation doctrine should be adopted by the State of Arkansas as its water code in order that full use of its vast water resources may be developed and the litigations that are bound to follow a riparian doctrine—or that are encountered in the conflict of the two doctrines—may be avoided.

Irrigation needs, State of Arkansas

Problem areas	Present and potential acreage [1]				Average annual water requirement (acre-feet)			
	Rice		Other crops		Rice		Other crops	
	Present	Future [2]	Present	Future [2]	Present	Future [2]	Present	Future [2]
White River Basin:								
Black River [3]	838	12,122		117,000	1,795	24,244		93,600
Village Creek [3]	4,900	13,000		55,000	9,800	26,000		44,000
Cache and Bayou DeView [3]	71,270	82,350		395,000	142,540	154,700		316,000
Big Creek [3]	18,580	68,530		140,000	37,160	137,060		112,000
Dials Creek [4]	690	1,150		5,000	1,224	2,610		4,000
White River, main stem [4 5]	74,218	96,261		377,975	133,592	173,270		302,380
White River, tributary area	0	0		266,885	0	0		213,508
Total	170,486	273,713	50,162	1,356,860	326,112	527,884	40,130	1,085,488
Arkansas River Basin:								
Lower Arkansas, main stem [4 6]	6,750	13,287		105,945	12,150	23,917		84,756
Upper Arkansas, main stem [4]	200	2,000		154,000	400	8,000		123,200
Bayou Meto [4]	73,459	81,000		243,000	132,226	1458,00		194,400
Grand (Neosho) River	0	0		30,000	0	0		24,000
Petit Jean River	0	0		18,180	0	0		14,544
Arkansas River, tributary area	798	0		185,115	1,596	0		148,092
Total	81,207	96,287	28,703	736,240	146,372	177,717	22,962	788,992
Red River Basin:								
Red River, main stem [3]	200	34,000		120,000	400	68,000		96,000
Red River, tributary area				192,820				154,256
Total	200	34,000	2,681	312,820	400	68,000	2,145	250,256
Ouachita River Subbasin (Red River):								
Boeuf River-Bayou Macon [3]	16,662	76,000		302,000	33,324	152,000		241,600
Bayou Bartholomew [3]	9,604	30,000		182,530	19,208	60,000		146,048
Ouachita River [3]	112	4,000		324,520	224	8,000		259,616
Total	26,378	110,000	6,000	809,080	52,756	220,000	4,800	647,264
St. Francis Basin: St. Francis, main stem [3]		140,000		585,000		280,000		468,000
Grand total	278,271	654,000	87,545	3,800,000	525,640	1,273,601	70,037	3,040,000

[1] Below Oil Trough, Ark.
[2] The future figure includes present figures.
[3] 2.0 acre-feet per acre for rice; 0.8 acre-foot for other crops (delivered-to-farm basis).
[4] 1.8 acre-feet per acre for rice; 0.8 acre-foot for other crops.
[5] Below Little Rock.
[6] Above Little Rock.

Senator FULBRIGHT. Mr. Chairman, I should like to introduce to the committee at this time Senator Marvin Melton, of Jonesboro, Ark. Mr. Melton is the chairman of the water resources development council in Arkansas. This organization, as I understand it, exists for two purposes—the passage of this legislation and the passage in the State legislature of a water rights law. Mr. Melton has done a great deal of work in connection with this matter all over the State of Arkansas, and in addition he served as the Governor's director for the emergency drought relief program last year. I am sure the committee will agree that Mr. Melton is well qualified to speak on this subject and I believe it will profit from his statement.

In addition to his being a State senator, he also operates a very substantial and highly successful stock farm in northeast Arkansas.

The CHAIRMAN. We will be glad to hear from Mr. Melton. But first I would like to ask the other members of the committee if they have any questions that they would like to ask of you.

We also have these other witnesses after Mr. Melton this morning. We have Mr. McLeaish, administrator of the Farmers' Home Administration and Mr. John C. Lynn, legislative director of the American Farm Bureau Federation.

Are there any questions that the members of the committee would like to ask Senator Fulbright before we ask Mr. Melton—also Senator Melton—to make his statement?

Senator SCHOEPPEL. I do not have any questions.

Senator THYE. Mr. Chairman, I would just like to thank the Senator for making this very firm, informative, and intelligent statement on the legislative measure before us and also for furnishing for the record the information that he has furnished, as well as the articles written by those who have made an extensive study of this question.

I fully agree with Senator Fulbright that we can go far in the development of irrigation projects throughout the Nation.

We find in Minnesota that they have put in not only the sprinkling systems, but where the land is flat enough to permit a flowback, they are irrigating in that manner. And there is no reason why we cannot proceed with such projects to produce crops as well as ditching and so forth to take away the excess moisture on our lands. It is all just a part of improving the efficiency of productive acres or our operating units.

For that reason, I am most happy that the Senator has made this informative statement.

(Discussion off the record.)

Senator FULBRIGHT. I wanted to say one other thing.

There have been great sums of money spent on flood control and I have supported this work; but actually I believe the loss over the years is greater from drought. Floods come occasionally and are very dramatic and kill people and destroy property all of a sudden. Droughts, as these studies will show, recur to some extent practically every year in quite large areas of my State. We have tremendous rains in the early spring and late fall. And many times during the summer it will go 30 days, 60 days, or 90 days without a drop of rain, particularly in the western part of my State.

I am convinced this bill can make a tremendous difference in what we would call incidental or supplemental irrigation during that period.

We have the surface water. All we need to do is to use it. We have a tremendous amount of surface water.

Senator THYE. You can put pipes out anywhere.

Senator FULBRIGHT. That is right. And better pumps have been developed; it is going to work, I think, in great shape and make all the difference in the world.

I think we will need all the production we can get in 15 or 20 years, notwithstanding the surpluses that plague us now.

You have in Minnesota, perhaps, a better water level than any State in the Union, Senator Thye, so you will be the last one to feel the lack of water.

Senator THYE. Yes. But last year we did not have rain from the month of August on into December. And if you had irrigated some alfalfa fields and the like, you could have had good pasture. You would not be so short of feed as you are in some of the areas right now.

Senator ELLENDER. Mr. Chairman, I am sorry I did not hear all of Senator Fulbright's statement, but I do know that he is interested in this. It will be recalled that Senator Eastland made a splendid presentation of the situation as it exists in many Southern States. Senator Fulbright has just pointed out that the surpluses we have now may be a godsend 25 years from now. We have to find ways and means to produce more on the land we have.

(Discussion off the record.)

Senator ELLENDER. Mr. Chairman, I expect to ask a few questions about the bill, but I understand that Mr. McLeaish, who is head of the Farmers' Home Administration, is here, and I shall ask him about the increase in the amounts of loans from $100,000 to $150,000 and how the act has been administered in the past.

The CHAIRMAN. We will hear Senator Melton's statement, which is a short one. Then we will hear from Mr. McLeaish.

STATEMENT OF MARVIN W. MELTON, CHAIRMAN, WATER RESOURCES DEVELOPMENT COUNCIL IN ARKANSAS, JONESBORO, ARK.

Mr. MELTON. Arkansas for the past 2 years has been one of the unfortunate States in having 2 of our very worst droughts. We produced very little feed and grass for our livestock. It was necessary for us to ship into our State about 1,800 cars of hay, to say nothing of the many carloads of corn, oats, and cottonseed meal, in order that our livestock economy might be maintained.

It was my duty, in connection with the hay-relief program, to make a tour of several Western States including California, Oregon, Washington, Idaho, Colorado, Montana, and Kansas. Those States shipped us the greater portion of our hay. In every case I found the annual rainfall in those areas shipping hay to be no more than 16 inches, about one-third of our annual rainfall in Arkansas, which is 48 inches. In other words, those States are properly using their water resources and have a surplus of hay and feed to supply to Arkansas and many other drought-stricken States with much more annual average rainfall, but with no organized system of conserving and using water.

This, of course, was a program financed to a large extent by Federal funds. In other words, the Federal Government had intervened to

assist farmers in localities suffering from the drought. It is interesting to speculate how much of this cost to the Federal Government could have been avoided if we had been farsighted enough to have provided this legislation several years ago. I dare say the Federal Government would have saved several million dollars.

Being associated with the banking industry of our State, I can assure you that we do not have local financing facilities to handle the irrigation problems that confront us. We are not in a position to make loans of the necessary duration to handle this type of a project. Unless the Pope-Jones Act is extended to our State, as well as many other States, the agricultural economy will be definitely curtailed.

The Arkansas-White-Red River Basins Interagency Committee, authorized by the 1950 Flood Control Act, had a survey made of irrigation needs in Arkansas. As a result of that study, made by agriculturists and engineers, it was found that there was a total of 3,800,000 acres in the State of Arkansas suitable for irrigation for crops other than rice. All that is needed to bring this acreage into irrigation is the proper use of the water facilities in the State.

You might be interested in knowing how irrigation affects some of our crops in Arkansas. Last year the University of Arkansas Experiment Station conducted an experiment of irrigating cotton. Even though 1953 was a better than average cotton season in Arkansas, they found that the production on the irrigated plot was a little more than one-half bale per acre greater than that of the nonirrigated plot. This meant more than $50 per acre increase.

In the dairy section they found that milk production increased from 2,680 pounds per acre to 4,300 pounds.

Strawberries last year on nonirrigated land in northeast Arkansas produced approximately $240 per acre. On irrigated land the yield was about $1,000 per acre.

Corn production also increased from 48 bushels to 72 bushels. We are very fortunate in Arkansas to have many running streams. In fact, it is said that we have more miles of navigable water within the bounds of the State than any other State in the Union. And I have seen crops and pastures deteriorating almost to the point of no production only because farmers had no facilities to use the water running past their lands. I cannot impress on you too forcefully our need for this legislation in Arkansas.

I understand that the Department of Agriculture is concerned about the water-rights laws of the States in which this program is to operate. This is a proper concern, because the Department, as a lender, must have the assurance that the borrower has a permanent legal right to use the water if the loan is to be repaid.

As Senator Fulbright said in his introduction, one segment of our committee is now and has been working on a water-rights bill for the past several months. We think by mid-June we will have agreed on a bill for introduction into our next session of the legislature which convenes in January 1955. We expect to spend much of our time between now and then appearing before civic clubs and agricultural organizations explaining the bill and doing whatever educational work is necessary in order that we will have no opposition in passing the bill at that time.

The CHAIRMAN. That is an excellent statement, Senator Melton.

Are there any questions?

Senator THYE. I have no questions. I agree with you, Mr. Chairman, that it is an excellent statement.

Senator SCHOEPPEL. Mr. Melton, in regard to this drought situation this last year, I had the opportunity of going down into your State.

With this new and improved method of irrigation, of laying these surface pipelines which are economical in cost, and as Senator Fulbright pointed out here awhile ago, with new and improved pumping systems, in my humble opinion there is going to be a complete revolution in the approach to this type of irrigation. It has been drawn to my attention that within the last year in a segment of 3 States, there have been over 3,000 additional installations along this very line that would be permitted to be financed under this bill. Those of us in the central-western area have felt that the westerners have had the jump on us, because they have had legislation wherein they received long-time amortization in working out some of those developments that have inured to their economic benefit, have rounded out the farming unit and permitted more people to occupy lesser tracts and be more productive. I do feel as you do that there are great potential possibilities. And, therefore, I was glad to join in this legislation.

Last year the only areas in Kansas that had a surplus feed crop of any consequence were from the southern half of my State. We could utilize this surplus in other sections of the State. That came as a result of irrigation. Another thing that Senator Fulbright pointed out awhile ago was that we dramatize floods. But the long-time history of dollars and cents loss will show up infinitely greater in the loss that we suffer by droughts that could be minimized by these new and improved methods of irrigation. I think we are just simply foolish not to take advantage of these improved methods.

Mr. MELTON. Our acre production in Arkansas, Senator, on beef cattle is about 350 pounds per acre on improved pastures. We think that is average production. In California, where I visited some of the irrigated pastures, I was told by the county agents and by the owners of those pastures that their production in many cases is more than a thousand pounds per acre, and up to 1,150 pounds per acre in some cases. They have no better land than we have; they have no better cattle than we have; they are just using their water the way that they need it.

You have to go out there and study those western areas as I did to appreciate what they have and how they are using their facilities and how little we are using ours. They would give their right arm in the West if they had the supplies that we have in Arkansas. They have from 11 to 16 or 18 inches out there, and yet they are happy. And they are feeding our cattle in Arkansas, because we are not using the natural resources that we have.

And with this increase of population of 2 million a year, and no great additional amount of land, this little surplus that we have today 25 years from now is going to dwindle away to where we are going to need to increase our production per acre in each State in order to take care of our own population.

Now, that is my great concern about it. I think we have wonderful opportunities in the South and East and everywhere else if we will only use them.

Senator SCHOEPPEL. I agree with you.

The CHAIRMAN. Senator Fulbright, we want you to feel free to enter into any of this questioning.

Senator FULBRIGHT. Thank you, Mr. Chairman. I endorse Senator Melton's statement. It is a very good statement.

The CHAIRMAN. I presumed you approved of his statement.

Senator FULBRIGHT. And his work on the Water Rights Act in Arkansas, I think, will prove to be of great assistance to other States that have not yet developed that legislation. He has been working on that for about 2 years. He has made a thorough canvass of the law in many other States from which they are trying to get the best features that can be included in the law. I hope it will be a model law.

Thank you very much.

The CHAIRMAN. We thank you for your interest in this, and for the information you have given us. As I have said before, this is not headline material in the present-day sense of the word. However, if we can enact legislation of this type, we might get honorable mention in some of the textbooks of the future.

Senator FULBRIGHT. There is one other thing I wanted to mention. The committee may know about it. They are experimenting in our rice area down there with some method to recharge the subterranean water level. It has been a problem that has interested hydraulic engineers, of course, for a long time. But I hope that this committee may, while it is not involved in that legislation, have an opportunity to at some later time support that legislation and appropriations. The Senator from Louisiana will have that opportunity on the Appropriations Committee. It could mean a great deal to many parts of this country if a way could be found to efficiently recharge these subterranean levels that are going down. The one in the Grand Prairie in Arkansas goes down about 10 inches per year. It is getting so deep now—as it has in California and other places—that the cost of raising the water is prohibitive.

Some of our areas have been abandoned for that very reason. It has gone so far that it costs more to raise it than it is worth. That is the type of thing we certainly ought to have our minds on for the future.

Senator ELLENDER. It may be that the bill now being considered by this committee which Senator Aiken referred to a while ago will probably do just that, because the idea is to arrest the falling water up in the creeks.

Senator FULBRIGHT. I have seen a description of our experiment. It is on a rather small scale in the Grand Prairie.

Doctor Engler, whom I mentioned, has been interested in it for some years. The difficulty, of course, is getting the ground to absorb the water rapidly enough to make it efficient.

The CHAIRMAN. I think the subject you have mentioned, the recharging of the subterranean water level, will undoubtedly come up in the future.

(Discussion off the record.)

The CHAIRMAN. You contemplate recharging it in the times of surplus?

Senator FULBRIGHT. Yes. The White River runs off every year tremendous amounts that go into the ocean within a very short distance.

We think maybe these dams on the upper White River may help. Of course, nobody knows how this water gets down there, I guess.

The CHAIRMAN. I would not consider recharging or raising the water table at all fantastic.

Senator FULBRIGHT. I do not think it is fantastic. We just do not know how to do it yet in an efficient manner, apparently. They are experimenting with it now.

Thank you very much, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Fulbright.

We will hear now from Mr. McLeaish.

Mr. MCLEAISH. Mr. Chairman, Mr. Scott has asked me to express his regrets at not being able to be here this morning.

I would like to introduce Mr. Henry Smith, Deputy Administrator of the Farmers' Home Administration; Mr. Charles C. Barnard, Director, Budget Division, Farmers' Home Administration; and Mr. Howard Rooney, Associate Solicitor for Agriculture Credit, Office of the Solicitor, United States Department of Agriculture.

STATEMENT OF ROBERT B. McLEAISH, ADMINISTRATOR, FARMERS' HOME ADMINISTRATION, UNITED STATES DEPARTMENT OF AGRICULTURE

Mr. MCLEAISH. Mr. Chairman and members of the committee, I am happy to testify in support of Senate bill 3137 amending the provisions of the act of August 28, 1937, commonly known as the Water Facilities Act.

This bill would make two changes in the Water Facilities Act.

First, it would make the provisions of the act applicable to the entire United States, including the Territories of Alaska and Hawaii, and Puerto Rico and the Virgin Islands. The benefits of the present act are limited to the 17 Western States, which are commonly understood to contain most of the arid and semiarid areas of the country.

The applicability of the present act only to the arid and semiarid areas of the United States grew out of the facts and recommendations contained in the 1936 report of the President's Great Plains Committee entitled, "The Future of the Great Plains." In these areas, the quantity, quality and availability of water for irrigation, livestock and domestic use are frequently the primary limiting factors to agricultural development and stability. The wastage and inadequate development and utilization of water resources are major contributing factors in the failure of many of our western farms to produce near capacity, and lead to crop failures and to a decline in the standard of living.

There is ample evidence of an extensive need in the less arid areas of the country for the development and improved use of water supplies for farm homes, for livestock, and for irrigation of small gardens.

The 1950 census of housing shows that more than one-half of the 5,660,000 occupied rural farm dwellings have no running water. This condition undoubtedly exists in many instances because of a lack of developed sources of water or a need for replacing or improving existing sources. Frequently the development or improvement of suitable water supplies is so costly that it cannot be accomplished by farmers from available farm income in any one year. The availability

of adequate credit on suitable terms for water development and utilization is one of the important factors in obtaining any desired improvement of this condition.

In areas of the country normally considered humid, there has been an increasing interest by farmers in water facilities to supplement rainfall in the production of some crops, in the maintenance of year-round pastures, and in the introduction of other practices for increasing production. The use of irrigation systems would prevent serious losses of income during periods of drought in these areas.

Although water facilities loans are now authorized in the 17 Western States, program operations relating to irrigation actually are limited to designated areas within those States. Before these areas were designated, it was necessary to conduct extensive technical studies into the availability of water resources, the feasibility of developing such resources, the proprietary rights to use water, and the adaptability of the soils for the utilization of the water resources and for sound farming operations. If the program should be extended nationwide, we would expect to conduct similar technical studies of areas in the other States. Until this could be done, the scope and rate of development of that phase of the program dealing with irrigation in the less humid areas would be difficult to forecast.

The second change is concerned with the size of water facilities loans. The present limitation of $100,000 on the amount of Federal financial assistance to any 1 water-facilities project would be repealed, and a limit of $250,000 placed on the outstanding principal indebtedness of any corporation or agency. Also, there would be a similar limitation of $25,000 placed on the principal amount outstanding to any individual, partnership, trust, estate, or unincorporated association.

One of the reasons requiring an increase in the loan limitation is the increase in the cost of materials and construction over the last several years. In addition, there is a need for loans larger than $100,000 among cooperative water-users associations, mutual irrigation companies, and irrigation districts. Usually, the members of such organizations are unable to raise their pro rata share of the cost of installations, and the organizations are unable to borrow the amount needed on suitable terms and conditions from commercial institutions. There is now no source of financing the construction or rehabilitation of the systems of such organizations if their needs exceed $100,000.

The limitation on the cost of water facilities projects financed under the Water Facilities Act first appeared in the acts appropriating funds for use under that act. The purpose of limitation apparently was to avoid any overlapping of activities under the Water Facilities Act and the activities under the reclamation laws. When the Wheeler-Case Act was amended by the act of October 1, 1940, which authorized more intensive development of smaller reclamation, flood control, and power projects, the limitation was enacted into basic legislation. No new projects are now being constructed under the Wheeler-Case Act, due to the fact that the formula for justification of such projects included the use of WPA and other relief labor, which is not now available.

The present limitation is as follows: "On any one project undertaken pursuant to the Act of August 28, 1937, entitled 'An act to

promote conservation in the arid and semiarid areas of the United States by aiding in the development of facilities for water storage and utilization, and for other purposes,' as amended and supplemented, expenditures for the construction, maintenance, operation, rehabilitation for financial assistance of anyone project, shall not exceed $100,000 of Federal funds, whether appropriated or allotted or both. All project facilities and appurtenances which depend for their utility in whole or in part upon each other or upon any common facility shall be deemed one project within the meaning of this section."

Now that the smaller reclamation undertakings are no longer being developed under the Wheeler-Case Act there exists a gap between the size of the facilities which can be undertaken now under the Water Facilities Act and the projects being developed under the reclamation laws by the Bureau of Reclamation. That gap should be closed. This bill would be a step in that direction. The change would make possible loans for the construction or rehabilitation of needed projects for which Federal assistance is not now available.

In addition, the present definition of the word "project" is extremely limiting and difficult of administration when applied to certain types of facilities which, although independently owned and operated, may be related by engineering features or by use of water to another project undertaken with Federal assistance under the Water Facilities Act. The proposed section 8 would, however, terminate the authority of the Secretary to do the construction work on projects. Thus, any overlapping of authority between the Bureau of Reclamation and the Department of Agriculture would be avoided.

The limitation of $25,000 on the outstanding principal indebtedness of individuals, partnerships, trusts, estates, or unincorporated associations is believed to be a practical proposal and one which would work no hardship on loan applicants. Loans to this type of borrower usually are for improvements to individual farms or very small projects, and we believe that $25,000 is a reasonable limitation at this time.

As you know, Mr. Chairman, enactment of this legislation was recommended by the President in his budget message submitted to the Congress in January. Its enactment would require additional loan funds and additional administrative expense funds in connection with making loans and servicing the loans outstanding. It is estimated that the amount of $5 million would be sufficient the first year for loans, and $350,000 for administrative expenses. The loan funds would be borrowed from the Secretary of the Treasury in the same manner as under the present program in which a loan limitation of $6,500,000 is available during fiscal year 1954.

The Water Facilities Act is being administered by the Farmers Home Administration and that agency would be responsible for administering the proposed broadened authority. Representatives of the Farmers Home Administration will be glad to answer any questions about the present program which has been one of the most successful loan programs the Department has ever undertaken.

Senator SCHOEPPEL. Might I ask this question: What has been your history of how that limitation to avoid any overlapping of activities under the Water Facilities Act and the activities under the

reclamation law has operated in the past? Has that not been pretty successful?

Mr. McLEAISH. It has been very successful.

Senator SCHOEPPEL. And you have had a very, very low ratio of losses, have you not?

Mr. McLEAISH. I think repayments have been about 99 percent of maturities.

Senator SCHOEPPEL. I have been informed that it is a very, very small percentage of loss.

The CHAIRMAN. Well, can you give us an idea of how extensive use has been made of the Water Facilities Act?

STATEMENT OF HENRY C. SMITH, DEPUTY ADMINISTRATOR, FARMERS HOME ADMINISTRATION, UNITED STATES DEPARTMENT OF AGRICULTURE

Mr. SMITH. Mr. Chairman, to date, since the program started, through December 31, 1953, we have made 17,308 loans to individuals, totaling $25,438,433. We have made 309 loans to groups, to associations, to incorporated groups.

The CHAIRMAN. All in the 17 Western States?

Mr. SMITH. That is right, sir.

Senator ELLENDER. What is your present limitation?

Mr. SMITH. The present limitation is $100,000.

Senator ELLENDER. What is your limitation as to how much you can loan out?

Mr. SMITH. $6½ million for fiscal year 1954.

Senator ELLENDER. Is that sufficient? Will that not have to be increased?

Mr. McLEAISH. If we go nationwide, it will, Senator.

Senator ELLENDER. Are you making any provisions in the bill to increase that loaning capacity?

Mr. McLEAISH. We have offered an estimate to the Bureau of the Budget.

The CHAIRMAN. For this year?

Mr. McLEAISH. For 1955.

The CHAIRMAN. Have you made the request on the basis of existing law?

Mr. McLEAISH. Yes. We have made our present request on the basis of existing law. Now, if this goes through, we will ask for $5 million more loan funds and $350,000 for administrative expenses.

The CHAIRMAN. Now, what is the record of repayment on the loans that have been made up to this time?

Mr. McLEAISH. It has been excellent, I would say. On total loans, 99 percent of total maturities.

The CHAIRMAN. That is as good as anybody's loans.

Have you made grants in the past?

Mr. McLEAISH. They have in the past. But none have been made in the last several years.

The CHAIRMAN. Would the proposed change in the limitation on Federal assistance permit assistance through grants in excess of $250,000?

In other words, could you lend $250,000 and make a grant for another $100,000 under the law?

Mr. SMITH. No. Under the annual appropriation for water facilities, the funds are available for loans only.

The CHAIRMAN. That has been handled through the appropriation bill?

Mr. SMITH. That is right.

Senator ELLENDER. Are you satisfied with that method of having the Appropriations Committee provide the funds on the yearly basis?

Mr. MCLEAISH. Yes. I think it is probably the best way to handle it, Senator.

Senator ELLENDER. When the loans that you make are repaid together with the interest, is that handled through the Treasury?

Mr. MCLEAISH. That goes back to the Treasury and we do not have the use of it any more.

Senator ELLENDER. What are your outstanding loans at present? Do you know?

Mr. SMITH. The amount of loans outstanding at the present time is $18,642,395.

Senator ELLENDER. What are the terms of your loans? Are they described in the act or do you have leeway in determining that?

Mr. SMITH. No, sir. The terms of the loans are established by the Secretary by regulations issued through the Department.

Senator ELLENDER. It is not fixed in the act?

Mr. SMITH. No.

Senator ELLENDER. It is left to his discretion?

Mr. SMITH. That is right.

Senator ELLENDER. As to the amount to be requested each year, does he estimate the amount he would probably need?

Mr. MCLEAISH. Yes, sir. That is the way that is done.

Senator ELLENDER. He makes that showing before the Appropriations Committee, and it is on that basis he gets the necessary money?

Mr. SMITH. That is right. I might say, Senator, that there has been a gradual increase in the amount of appropriations for water facilities.

Senator ELLENDER. Yes; I understand that.

In fixing these terms, what length of time does the Secretary usually allow?

Mr. SMITH. On group loans?

Senator ELLENDER. For repayment?

Mr. SMITH. In the group loans, the loans may be established over a period of 40 years or less, depending upon the forecast of the repayment ability of the association. In the matter of individual loans, the repayment schedules are established for 20 years or less, depending upon the forecast of the individual's ability to repay the loan.

The CHAIRMAN. What has been the limitation on the individual loans?

Mr. MCLEAISH. Up to now I do not think we have had any limitation. Our highest loan up to this time has been $15,000 to individuals.

The CHAIRMAN. That is, you have been limited more or less by the general law affecting the Farmers' Home Administration?

Mr. MCLEAISH. That is right.

Mr. SMITH. And by administrative direction.

Mr. MCLEAISH. Yes. And by administrative direction.

The average loan at the present time is around $4,500.

The CHAIRMAN. What has the average loan for the community facilities been running?

Mr. MCLEAISH. About $40,000.

The CHAIRMAN. About $40,000?

Mr. MCLEAISH. Yes, sir.

Senator ELLENDER. I notice that you are placing in the record a limitation of $25,000 on the principal amount outstanding as against any individual.

Is that irrespective of the size of the farm?

Mr. SMITH. That is right, sir. The assistance by administrative direction has been limited to farmers who are operating farms not substantially larger than family-type farms.

Senator ELLENDER. Suppose someone decides to operate one of these large farms. He would be precluded under this act, would he not?

Mr. SMITH. He would be precluded from assistance under our regulations, yes, sir.

Senator ELLENDER. Now, this assistance to which you refer is loans only as you have just indicated?

Mr. SMITH. Loans together with engineering assistance, technical assistance.

Senator ELLENDER. How is the rate of interest fixed?

Mr. MCLEAISH. The rate of interest is fixed administratively. At the present time it is 3 percent.

Senator ELLENDER. Three percent?

Mr. MCLEAISH. Yes, sir.

Senator ELLENDER. Would the Administrator have the right to fix any rate which would be lower than that which is paid by the Treasury in borrowing money to operate it?

Mr. MCLEAISH. I think you would legally have the right to do it, but I do not think it would be good business.

Senator ELLENDER. Have you any instances where he loaned money out under the going rate?

Mr. MCLEAISH. I think probably a year ago the Treasury, if I remember correctly, was paying 3¼ percent for some money. And this rate is 3 percent to the farmer.

Senator ELLENDER. Well, the reason I asked that is: that may be a hurdle over which we may have to jump in presenting this. It strikes me that the rate of interest fixed by the Secretary under those circumstances should not be less than that which the Government itself has to pay to get that money.

Mr. SMITH. These funds are borrowed from the Secretary of the Treasury at the rate of interest established by the Secretary of the Treasury.

Now, that has no relationship in fact to the amount of interest rate charged to the farmers. As Mr. McLeaish said, certainly the interest rate charged to the farmer ought not to be less.

Senator ELLENDER. Well, you say that the rate is fixed not by the Secretary of Agriculture, but by the Secretary of the Treasury?

Mr. SMITH. That is right.

Senator ELLENDER. And that rate is what he must pay for the money?

Mr. McLEAISH. Senator, there is another factor which I know had not appeared in the legislation, but I know it is being considered. That would be the possibility of insuring these types of loans in the same way as we insure farm-ownership loans. And under that circumstance, I think a rate of interest should be along the lines of the money market at that time, as to what it takes to get the money from lenders.

The CHAIRMAN. You mean the local people could conceivably provide the money on an insured-loan basis?

Mr. McLEAISH. Yes, sir.

Either that or insurance companies or large banks could provide the money.

The CHAIRMAN. Do you need legislation to do that?

Mr. McLEAISH. Probably we will need it, Senator.

The CHAIRMAN. Do you think it should go in this bill or would it be an amendment to the general Farmers' Home Administration law?

Mr. McLEAISH. I think it might well be an amendment to the Bankhead-Jones Act; because we already have an insurance fund set up in that.

Senator ELLENDER. For homes?

Mr. McLEAISH. For farm-ownership loans.

Senator ELLENDER. All you would have to do would be to extend it?

Mr. McLEAISH. Extend it to cover this insurance feature.

Senator ELLENDER. Would the one now provided for homes be sufficient?

Mr. McLEAISH. I do not think it would go this far. Now, the one that provided for farm enlargement and farm development would take care of some small water installations.

Mr. SMITH. The fund would be sufficient, Senator.

Senator ELLENDER. Yes. That is what I am talking about. In other words, all you would have to do if the Congress decided to pursue that course would be simply to extend the present law to cover these facilities?

Mr. SMITH. Loans under this act; yes, sir.

Senator SCHOEPPEL. Mr. Chairman, I would like to ask this question: Do you not think, Mr. McLeaish, that the success of this program has been largely because you have had some reasonable limitation upon the individual or the group loans?

Mr. McLEAISH. That is correct, sir.

Senator SCHOEPPEL. Because it has very definitely encouraged your family-type farm.

Mr. McLEAISH. That is correct, sir.

Senator SCHOEPPEL. And I would hesitate and dislike very much to see too high a figure placed upon something where an individual or group of individuals could go; because I think it would be a detrimental factor.

Mr. McLEAISH. Well, usually the man with a pretty large farm can get credit somewhere else.

Senator SCHOEPPEL. That is the very point I am making. When you get into the large units, there is an element of speculative venture in it. A man who wants to play that kind of game can seek financing some other place.

Senator ELLENDER. Senator, I was merely exploring the matter.

Senator SCHOEPPEL. Yes, I understand, Senator Ellender.

Senator ELLENDER. I was exploring the matter in order to get all the facts before us so that when we come to mark up the bill we will have available the necessary information. Now, in regard to this other method, it is a very popular method now and one which would take the Government out of the business of making these direct loans and thereby increasing the debt.

It strikes me that it might be well for us to look into the feasibility of just having these loans guaranteed. You might make it so that the banks could loan this money instead of the borrower getting it from the Treasury. I believe that since we are holding hearings we ought to explore that possibility so that we can have the facts and data before us when we make up the bill. That was my reason for bringing it up.

Mr. MCLEAISH. I am heartily in favor of using as much private capital as we can at reasonable rates.

Our people should do the technical work and supervise the loans the same as we do now. I would not want to get in the position of giving some banker a carte blanche to make loans that we guranteed.

Senator ELLENDER. You do not want to get in the position that the banking committee is now in with the FHA. I know that and in any event, we ought to put all the safeguards necessary in the bill to prevent that if we decide to pursue it along the lines that we suggested.

What would you think of an alternative plan; that is, letting the plan go as you are now administering it with the provision that if you desire to take the other, you might do so?

Mr. MCLEAISH. I think that would be excellent.

Senator ELLENDER. Both plans?

Mr. MCLEAISH. In other words, at times when money was scarce we might want to use direct appropriations. And money is now somewhat free.

Senator ELLENDER. That would be feasible; would it not?

Mr. SMITH. That is the authority we now have under the Bankhead-Jones Act with respect to farm-ownership loans.

The CHAIRMAN. A simple amendment to this bill would extend it; would it not?

Mr. SMITH. Mr. Chairman, I would like to put this figure in the record.

This is information with respect to the success of the program. Since the inception of the program, to date the principal writeoffs for loans made amounts to $9,700.

The CHAIRMAN. Out of twenty-odd million?

Mr. SMITH. That was out of $32 million.

Senator ELLENDER. Mr. Chairman, may I suggest that the Department prepare an amendment that would extend this method of financing along the same line as housing just for the consideration of the committee.

The CHAIRMAN. The Chair was going to suggest at the conclusion of the testimony this morning—and it might as well suggest it now—that Senators Thye, Schoeppel, and Ellender take this bill in hand working with the committee counsel and with the Department and then make sure that it is in the proper form to come before the com-

mittee for executive action. Then if we agree on that, we will introduce it as a committee bill, and we can report it favorably the same day

(Discussion off the record.)

Senator THYE. I think Mr. Stanton could use the language that is now in the other act and make it applicable to this act. And then we have it.

The CHAIRMAN. Are you satisfied with the $25,000 limitation for an individual?

Mr. MCLEAISH. In view of our experience, I think $15,000 has been our top up to now.

Senator ELLENDER. Do you think $25,000 is the right amount, or would you suggest less?

Mr. MCLEAISH. I think that $25,000 would give us some latitude.

Senator THYE. That is, for a family-type farm of 160 acres or more?

Mr. MCLEAISH. Yes, sir.

Senator THYE. And that type of equipment should get cheaper rather than more expensive, because they have done so much research in pipes and pumps and the like. You are trying to hold it somewhere near the family-type farm?

Mr. MCLEAISH. Yes, sir. In other words, it will be a group consisting primarily of family-type farmers.

Senator THYE. What does it average out in acres now?

Mr. SMITH. You mean on the group loans?

Senator THYE. I mean in the individuals. In the number of loans how many acres does it average per family? Do you have that figure?

Mr. SMITH. A hundred and ten acres in irrigated land.

Senator THYE. So that 160 would be practically your maximum to individuals?

Mr. SMITH. That is right, sir.

Senator THYE. You are avoiding this corporation-type farm unit getting an extensive loan and going out here and becoming what you might call a corporate-type operator?

Mr. SMITH. That has been it.

Mr. MCLEAISH. Senator, I have operated a corporate-type farm, and I do not think it should be in on this type of loan.

Senator THYE. I would say the same thing, because what you are concerning yourself with is the family-type farm, and you want to maintain a family-type unit in America. You just do not want to see corporations or big ownership superseding the man who grubbed out the timber or broke up the virgin prairie.

Senator ELLENDER. I was questioning the amount of these loans. Now, you have a quarter of a million dollars there.

Mr. MCLEAISH. That is for a group of family-sized farms.

Senator ELLENDER. Are you limiting that group to a certain number of farms?

Mr. MCLEAISH. No. I think the experience has been that you would take whatever condition exists. Do you know what brought about the increase to $250,000, Mr. Smith?

Mr. SMITH. We have a list of about 20 or 25 inquiries or applicants from the 17 Western States that could not be served under the $100,000 limitation.

Senator ELLENDER. How many farms would be involved in that?

Mr. SMITH. From 20 to 30 farms.

Senator ELLENDER. In other words, the average would not be higher than if they applied individually?

Mr. SMITH. No. Now, there probably will be come additional numbers of farms where the association is borrowing money for domestic water.

Senator ELLENDER. Now, what is your form of security there? How do you go about it? Do you take a mortgage on the facility only?

Mr. MCLEAISH. We take a mortgage on the farm or whatever is available. We might take a second mortgage but we take all the security available, including the mortgage on the farm.

Mr. SMITH. And on the group loans we take a mortgage on the group's property, on the water rights that it owns, and also on an assignment on the monthly fees or annual fees that they will pay to the association for the use of the water.

Senator ELLENDER. When you make a group loan, is each individual responsible for his pro rata share or for the whole of the loan?

Mr. SMITH. The loan is made to the incorporated group.

Now, in some of the States in the West, the annual charge for water that the individual farmer agrees to pay becomes a lien on his farm. And we take an assignment of that right.

Senator ELLENDER. I see.

Senator THYE. Mr. Chairman, the question that occurs to me is: When a group enters in, what is the reason for the group joining in making application? Is it a required pipeline or a ditch that would convey the water any distance in order that it would be made available to the group once it got into the valley or into the area?

Mr. MCLEAISH. Well, it is a matter, Senator, of a lower cost in group organization. In other words, they drill one well which serves a group of people for domestic or irrigation water.

Senator THYE. Then it could serve a dozen or more farms?

Mr. MCLEAISH. That is right.

Senator THYE. If it is bringing it in from a lake or bringing it in from a stream, then it is a question of having to lay a main pipeline to convey it to the area in which you are going to use it. If it is a question of putting up a dam to impound water, there again the group would join in the impounding of the water, and then it would be made available.

Mr. MCLEAISH. That is right.

Senator THYE. So that is the reason for your group?

Mr. MCLEAISH. That is right.

Senator THYE. Mr. Chairman, I think we are ready here, with the exception of just that other phase of the loaning. And, as far as the bill is concerned, I could not offer a suggestion here now as to how it should be changed or amended. Our counsel, Mr. Stanton, can go through it from the standpoint of the language in each of the chapters.

The CHAIRMAN. Well, if that is agreeable, we will have it put in shape, and we will probably have an executive meeting Monday.

(Discussion off the record.)

The CHAIRMAN. The next witness is Mr. John C. Lynn, legislative director, American Farm Bureau Federation.

Mr. LYNN. Mr. Chairman, my statement is very brief.

STATEMENT OF JOHN C. LYNN, LEGISLATIVE DIRECTOR, AMERICAN FARM BUREAU FEDERATION

Mr. LYNN. The American Farm Bureau Federation recommends the enactment of S. 3137, extending the provisions of the Water Facilities Act to the entire United States and outlying territories.

The original act, passed in 1937, has been applied only to the 17 Western States which are classified as arid and semiarid areas. Any argument that may have existed at that time for the limitation of the Water Facilities Act to the arid and semiarid areas has disappeared as a result of the widespread interest in and demonstrated success of supplemental irrigation in most areas throughout the United States.

The advantages to the individual farmer of irrigation wherever water may be economically and feasibly developed needs no repetition before this committee. Even disregarding the hazards of drought, irrigation insures high dependable yields of high-quality agricultural products and efficient use of land and labor resources resulting in lower cost of production. The expanded use of water in agriculture promises to be one of the revolutionary developments of our time, comparable to the expansion in the use of fertilizer or the replacement of animal power by mechanical power.

Admittedly, increased production of most agricultural commodities is not needed at this time. However, the widespread development and use of water in agriculture is not something that will happen overnight. The expansion in the use of water will require research, experience, and gradual development over a period of the next several decades. In the meantime we have confidence that farmers can solve the current agricultural surplus problem with proper legislative guidance and the vigorous administration of a sound, long-range program.

Maximum production per man and per acre and the efficient utilization of resources is the basis of agricultural and national prosperity and strength. We recommend favorable consideration by this committee and the Congress with regard to this measure.

Mr. Chairman, if I might add one addition to this, I was quite interested in the discussion here with regard to using insured loans for this purpose. I think that is a very good idea. I would point out though that the small-town bankers, which we would hope would participate in this, have a little difficulty, even though the mortgages are insured, in extending credit over an extended period of 20 or 30 years as anticipated in this act.

However, I think that could be worked out.

The CHAIRMAN. Well, I was thinking that almost every small town has investors who have some funds, as well as the bankers. But if the banks will not make the loans, the Farmers Home Administration would still be available to do it.

Senator ELLENDER. As I understand it, some of these loans could be taken over by the small banks and they could rid themselves of them within 2 or 3 years under the present law as it is now being administered.

Mr. LYNN. Yes. That is right.

Senator ELLENDER. It would not be a question of having them hold the loan for 20 or 30 years, but merely facilitate the matter and hold it as long as it desires and then return it to the Government.

Mr. LYNN. Yes. I think it would be a good addition to this measure.

The CHAIRMAN. Thank you, Mr. Lynn.

We have a statement submitted by John A. Baker, assistant to the president of the National Farmers Union. That organization also favors the enactment of the legislation and Mr. Baker's statement will be inserted in the record.

(The statement referred to is as follows:)

STATEMENT FILED BY JOHN A. BAKER, ASSISTANT TO PRESIDENT, NATIONAL FARMERS UNION

National Farmers Union approves in principle legislation introduced to expand the water facilities loan program to the entire United States. In expanding this program, however, attention should be given to the matter of increasing appropriations. It goes without saying, almost, that the need for water development in the 17 Western States far exceeds the $6,500,000 requested by Secretary Benson. Further expansion of the program will, of course, bring about the need for substantial additional funds if anything more than a token effort is to be made to meet the pressing needs for farmers for facilities to obtain additional water for pastures and growing crops.

National Farmers Union has recommended in appearances before the Senate and House Appropriations Committees that appropriations for water facilities loans be increased to $13,500,000 in the area being served under existing legislation. It is further recommended that this committee instruct the administrator of the Farmers Home Administration to prepare estimates of any deficiency appropriation he may find is required in connection with the administration of an expanded water facilities program.

Supplemental irrigation in humid areas east of the Mississippi River should not be looked upon only as insurance against periodic drought. Farmers in humid areas who have put in irrigation systems report that increased production in years of normal rainfall will pay for an irrigation system in 3 or 4 years. In a drought year such as that which caused widespread disaster to farmers in the Southeastern States last year, a system would pay for itself in an even shorter time.

The United States Department of Agriculture has made available comparative costs of beef production in the Pacific Northwest, which has long dry summers. These summers are very similar to those in the Southeastern and other Eastern States. Without irrigation beef production in the Pacific Northwest seldom exceeds 250 pounds per acre. With irrigation, however, 600 pounds of beef can be produced per acre.

Experiments in Virginia, reported by the United States Department of Agriculture also show a gain through irrigation of 3,000 pounds of alfalfa per acre—dry weight.

Farmers who have obtained water facilities loans through the Farmers' Home Administration have realized phenomenal success through irrigation in production gains. The average gains reported by 213 Farmers' Home Administration irrigation loan borrowers who repaid loan in full in 1950, 1951, and 1952 are as follows:

Average corn yields increased from 15 to 54 bushels per acre.

Average small grain yields increased from 14 to 28 bushels.

Average milk yields increased 39,477 to 49,651 pounds per farm.

Average cotton yields increased 198 to 421 pounds per acre.

Net worth of these farmers, many of whom occupy farms in submarginal areas, increased from $10,650 to $26,600 and net cash farm income from $2,300 a year to $6,200 a year.

In support of increased appropriations for water-facilities loans for the entire United States, consideration should be given to the fact that all of the money loaned under this program is in the form of self-liquidating investments and will all find its way back, plus interest, into the Treasury of the United States. The funds authorized for use under this program will be repaid or returned to the Treasury as follows:

(*a*) Loans paid directly.

(*b*) Interest of the loans will repay salaries.

(*c*) Increased income-tax receipts each year will offset such items as cost of the money loaned and any losses on loans.

(*d*) Increased production of our basic resources, land, and people contribute directly to our basic national income by furnishing the commodities which are a foundation for doing business.

(*e*) Aside from the dollars-and-cents approach to benefit to be derived from the program is the strengthening of our family-type farmers and, through them, the strengthening of the Nation's family farm pattern of agriculture.

There is need in the West for an expanded water-facilities program as reflected by the ever-increasing demand of individuals, cooperative water associations, and other groups that, through cooperative effort, desire to develop or improve facilities for domestic water supply or irrigation of crops and pastures. There is ample evidence also of an extensive need in the less arid areas of the country for the development and improved use of water.

According to a preliminary report of the 1950 Census of Housing approximately one-half of the 5,894,000 occupied rural farm dwellngs have no running water. The expanding of the water-facilities loan program should result in an improvement in the situation within a short time if adequate appropriations are made available by the Congress. Certainly, there would be little advantage in expanding the program without increased funds to meet the inevitable increase in loan applications for such assistance.

A large number of the farm dwellings with no running water are located in the States to which it is proposed that the program be expanded. Availability of water-facilities loans in this area is certain to result in improved living standards for farm families. Again, however, progress in this direction can be made only if adequate funds are available.

The development and improvement of water sources requires a substantial outlay of capital. Many family-type farmers are unable to repay such costs from farm income over the repayment periods established by banks and other commercial-credit sources. The availability of credit with repayment geared to farm income is an important factor in helping these families improve their living standards.

According to the 1940 census of irrigation, there are some 5,200 non-Federal group irrigation projects in the Western States served under existing legislation. Many of these were formed with limited capital. Others have yet to reach the objectives set for enlargement and improvement. Some need repairs. There is a potential need on the part of these group irrigation projects for credit to continue to serve the needs of their members. While this committee does not have under consideration at this particular time appropriations for the water-facilities program, it is hoped that the credit needs of non-Federal group projects will not be overlooked.

In this connection there are also Federal projects which have submitted applications but have not been able to obtain the funds needed to begin work or complete work already begun. The needs of these group associations should be carefully studied and the funds appropriated used to render assistance to as many families as possible.

National Farmers Union is aware that many small-group projects are not suited to receiving aid through the Farmers' Home Administration or the Department of the Interior. It is understood that one provision of S. 3137 raises the limit on loans to cooperative water associations. However, the gap between water-facilities loans and irrigation and reclamation loans through the Department of the Interior is still too wide to meet the credit needs of all small group water associations that desire assistance.

An expanded water-facilities loan program is needed to bring about better living standards for rural citizens. We see no reason, therefore, for any comprehensive study of the needs of eligible applicants. Farmers' Home Administration has demonstrated already, through the water-facilities program, that it is an effective means of helping disadvantaged people to become self-supporting and self-reliant citizens of their communities.

The limiting factor in the administration of a more effective water facilities is the lack of sufficient appropriations to get about the job of helping farmers in a really important way. Rural poverty and substandard living is obsolete in America and should be abolished. The expansion of the water-facilities program and increased appropriations is one step in the right direction.

The CHAIRMAN. No one else has asked to be heard on this. There has been no opposition registered to the bill. We will have Harker Stanton, committee counsel, prepare the necessary amendment which

has been discussed here this morning and take it up for action at our next executive meeting of the committee.

The committee is adjourned.

(Whereupon, at 11:25 a. m., the committee adjourned.)

(Statement filed by Hon. James O. Eastland, United States Senator from the State of Mississippi.)

STATEMENT SUBMITTED BY SENATOR JAMES O. EASTLAND

On April 22 I gave a speech on the floor of the Senate in which I discussed in considerable detail the importance and feasibility of supplemental irrigation in humid areas. I would like to supplement that speech at this time by having included in the report of this committee several magazine articles of unusual merit.

The first three are from the Progressive Farmer of February 1953. Incidentally, this edition of the Progressive Farmer contains several other outstanding articles on the subject and the editors of this periodical are to be congratulated on their foresightedness in arousing interest throughout the South in irrigation.

The next article is from the Farm Quarterly magazine for the spring of 1954.

Fortune magazine for March 1954 also contains a splendid article on the water resources of the United States. Since the feasibility of irrigation depends so much on easily accessible ground water. I wish it were possible to reproduce one of the maps printed in Fortune showing the Nation's ground-water resources. Since it is not possible to reproduce this colored map, I would like to list herewith the approximate percentage of area in various States known to be underlain with accessible ground water. I am including only the larger States which are most favored with such water resources in this list:

	Percent		*Percent*
Mississippi	98	North Carolina	65
Wisconsin	98	Iowa	60
Florida	95	Tennessee	60
Michigan	95	Minnesota	50
New Jersey	90	Illinois	50
Alabama	85	Texas	50
Louisiana	80	Kansas	50
Nebraska	80	Virginia	50
Missouri	70	Indiana	45
Georgia	70	Ohio	45
Arkansas	65	Washington	45
South Carolina	65		

A glance at the above list will show that all the States in the southeastern portion of the United States are included in the areas most favored by nature with abundant ground water resources.

I should also like to put into the record at this time a letter from Hon. Duke Humphrey, former president of Mississippi State College and now president of the University of Wyoming, and also head of the committee on irrigated agriculture and water resources of the Association of Land-Grant Colleges and Universities. It is indeed gratifying to know that the proposed extension of the Water Facilities Act to humid areas will have the encouragement and support of the agricultural leaders in the irrigated West.

"I'M STRONG FOR IRRIGATION"

(By Jesse B. Hearin, former president, Production Credit Corp. of New Orleans)

I would like to see our agricultural leaders, including the agricultural colleges, the county agents, and others, stress irrigation.

I know of some 8 or 10 projects that have been financed by the production credit associations in the last year. Not one of them has been a failure; on the contrary, every one of them paid. Most of them have been so profitable as to pay for the full cost in 1 year.

Nature has been good to us in many places; we have many rivers and creeks and branches, overflowing artesian wells and big springs that could easily be harnessed to provide irrigation for small and large tracts.

I know of a dairy farm, a large dairy farm, where the owner irrigated 80 acres of his pasture. When the long drought came last summer this 80 acres meant

more to him than the 400 acres of his other pasturelands. He had 4 cross fences on this 80 acres, and it is hard to believe that irrigation and fertilizer could have made 80 acres produce as much grass and clovers as this place was made to yield. In 1 year it more than paid for the cost of irrigation.

Another instance that I recall is a man who had 180 acres in corn. He irrigated 40 acres. When the sustained drought hit his section, in spite of the fact that all the land was well fertilized, cultivated, and planted with good seed, the 140 acres yielded only 24 bushels of corn per acre, while the 40 irrigated acres yielded 122 bushels per acre. It is not necessary to say that this man will irrigate a larger portion of his place next year.

There is nothing we can think of that offers greater possibilities to the people of our section than more irrigation projects. Portable irrigators could be made easily and at not too great a cost in many of our sections. If the ground is well drained and then irrigated, it insures a good crop under nearly all conditions.

Irrigation Mistakes To Avoid

In visiting with farmers over the South who are irrigating, we have learned that 'most everyone can tell you of mistakes he has made. Here are some of most common ones.

Short water supply.—We visited a number of farmers last fall who said, "I'd be irrigating today if I had the water. My lake is dry." Authorities say you need enough water reserve to apply at least 8 inches of water annually. In normal years you may not need over half this much. In ponds, where you have evaporation and seepage and with no live stream inflow, you need a reserve storage of 18 inches for each acre to be irrigated.

If your water comes from a live stream, check it during dry season.

Buying pump, pipes, sprinklers, and power unit without an engineer to help you survey and determine your needs.—Usually this results in an inadequate system. In some cases farmers have bought more than they needed.

Overrating power unit.—Many farmers have burned up their tractors by overloading. Same thing has happened with old automobile engines. Only about 75 to 80 percent of the brake horsepower on these engines can be used for continuous running. In pumping for irrigation, your load is constant. Be sure your power unit is adequate.

Inadequate planning of systems.—With a thorough study of your problem and help from engineers in planning your system, many mistakes may be avoided.

Many farmers are not using their systems enough.—It takes a little more time and effort than originally thought. Keep your system busy when needed.

Trying to irrigate too much with too little is another common mistake.—One farmer thought he was set up to irrigate 80 acres. He found he could get better returns from his water supply and investment by concentrating on 40 acres.

Another common mistake is applying too little water at each setting.—This means moving more often and coming back quicker.

Applying too much water and too fast is another error.—You waste water, fuel, fertilizer, and soil.

Lagging behind schedule in coming back with water is a mistake often made.—Sometimes farmers wait and keep thinking it's going to rain. Apply water before your crop begins to suffer.

Not using enough fertilizer to get maximum efficiency from water applied is another mistake.—To grow a bigger crop, you need more fertilizer. Use recommendations of your experiment station.

Use water on crops that will pay.—Use on high value crops first—vegetables, tobacco, dairy pasture.

What Power Unit for Irrigating?

The power unit you will need for your irrigation system will be determined by: (1) size of your system, (2) investment you want to make, (3) future irrigation plans, (4) hours you will want to operate, (5) availability of electric current, etc.

1. Tractor power.—Many farmers are using their tractors to start with. In this way their original cost is kept down and they get valuable experience on a small scale.

If you use your tractor get the help of an engineer in designing system so tractor won't be overloaded. An overloaded motor uses lots of fuel and it's hard on motor.

2. Auto and truck engines.—Many farmers are using used automobile and truck engines. These make satisfactory power units when properly set up and run at recommended speeds for continuous use. A 100-horsepower rated automobile engine will develop considerably less power at the recommended speed.

Usually the cooling system is not adequate when engine is placed under a continuous heavy load. You may need a bigger radiator. A small tube from discharge line from pump to cooling system will be all right. Some use a drum of clean water when pumping from a fertilized lake rather than run lake water through the radiator.

3. Industrial engines.—Many farmers are using these power units, both gasoline and butane. In almost all cases they have been satisfactory, either where close-coupled or flexible-coupled (units to pumps). Manufacturers will not overrate or overload the engine.

4. Diesel engines (new and used).—Specialists say that if your system requires (1) above a 60-horsepower unit, and (2) 1,500 hours or more of operating time annually, and (3) if you do not have 3-phase electric current or, (4) a permanent installation is not practical, diesel power will likely be your cheapest source of power. Initial cost of a diesel motor is high. But if you have lots of work to do, savings in fuel and service will soon pay for additional cost.

5. Electric motors.—Generally, electric power is most economical power to use, (1) if 3-phase current is available, and (2) if you have enough work to justify minimum monthly cost and (3) if a permanent installation will fit your setup.

Of course you can irrigate a small acreage from single-phase current. It's possible to use up to 7½-horsepower electric motors that way.

To justify the minimum monthly charge on a large electric power unit, your system will have to be used considerably. Some have worked out arrangements with power companies designating the months unit will be used, and got a reduction in minimum monthly cost.

[The Farm, Spring 1954]

Irrigation Will Pay Off in the Midwest

(By Grant Cannon)

In the spring when you stand in the doorway and watch the rain pour down and you want to get to your plowing, and the feedlot is a sea of mud, it takes a real contrary man to think of irrigation. But when August comes and the sun glares out of a copper sky and the corn rolls up and turns brown, then you wish you had done something about water. And this same thing goes on year after year, and you ask yourself, "Will a man never learn?"

As a Midwest farmer said the other day, "If you've got the water, farming without supplemental irrigation in the Corn Belt is about as sensible as trying to farm without using fertilizer. And there are a lot of farmers who have the water or can develop it who haven't given irrigation a second thought. If they don't start thinking soon, they'll be out of competition, or so hemmed in with water laws, they will have twice the trouble setting up a system, for irrigation is bound to come.

"We get enough rain during the year to classify this part of the country as humid," he continued, "but , as every farmer knows, if you don't get the rain when your crops need it, you might as well be farming on the desert. We had a drought last year, yet some States had as much rain as they normally get—it was just spaced wrong. I doubt if there is more than one year out of four when the rain falls just right for growing crops."

In the Midwest irrigation pieces out short rainfall, or it fills in during the dry season when the crop is in the "money" stage. For example, corn needs 12 inches of rain from June to September to make a maximum crop. That is just the season when there is likely to be a drought. If only 6 inches fall, then irrigation would supply the lacking 6 inches. The farmer can, with irrigation, harvest a maximum crop every year.

Supplemental sprinkler irrigation is proving to be the answer to fickle weather. The system is simple; water is pumped onto the field through pipes which can be easily moved. The sprinklers shower an inch or two of water on a strip, and then are moved down the field, a strip at a time, until the entire field is covered.

Foresighted farmers who have installed systems and have had a chance to make comparisons, say it pays off. In Tennessee, dairy farmers made a net gain of $121 in milk production per acre on irrigated over unirrigated pasture in 1951, and $110 in 1952. This is after the cost of depreciation, interest, and

operating expenses of the irrigation system had been deducted. In Georgia, twice as many steers were pastured on irrigated pastures as on rainwatered land and dairy farmers were able to figure an increase of 4 to 7 gallons more milk per acre each day from their irrigated pastures. In Indiana, a corn farmer who has a reputation for his accurate bookkeeping, reports that his 1952 crop showed a difference of $93 an acre in favor of his irrigated corn after he had charged off depreciation, interest, and cost of operation of the system. South Carolina, where Clemson College is preaching supplemental irrigation with the fervor of a convert to a new religion, reports cotton yields that have been more than doubled by two applications of irrigation water to supplement the rain, and several cases of corn yields which were jumped from a puny 8 bushels an acre for unirrigated corn to anywhere from 73 bushels to 134 bushels for irrigated corn. When it comes to tobacco, a Kentucky farmer said, "Does irrigation pay? Listen to this. In 3 years with irrigation I've bounced my yields 400 to 700 pounds an acre more than my neighbors who don't irrigate and the price I get for my tobacco is 5 to 10 cents a pound more than they get. Man, it's like having your acreage allotment doubled."

These reports, plus their own experinece through wet and dry seasons, have convinced farmers like Tom Pottenger and his father, Meade Pottenger, who raise 125 acres of sweet corn in the valley of the Great Miami River in Ohio, that supplemental irrigation pays off. "There's no question but what an irrigation system is expensive," Pottenger said. "The system we are buying cost about as much as two good tractors, but if we'd had it last year we could have paid for it twice over from our corn alone. In average years we figure that a system will pay for itself in increased production over a period of 3 or 4 years. It could do it in 2 years if you get a drought."

Pottenger is fortunate in having two good sources of water supply, the river and a shallow well, each of which will produce the necessary 500 gallons per minute it will take to supply his system. With many farmers, water supply will be the most troublesome of the three important elements of an irrigation setup—water, engineering, and equipment.

WATER SUPPLY

There are three major sources of water for irrigation: rivers and streams, lakes and ponds, and wells. Any one source may prove adequate, though some farmers have combined two or more to make out.

Where the farmer's land lies along the banks of a river he has ripa'ian rights to the use of the water. The riparian rights (riparian means riverbank) entitle him to a normal use of the water on his own land as long as his use does not interfere with the rights of others downstream. These rights are only vaguely defined by existing State laws. A farmer also has riparian rights to the use of water from a stream flowing through his farm.

A simple measurement can be made to determine the streamflow to find if he has enough water for an irrigation setup. The measurement should always be made during the dry season to find out how much water is flowing when it really counts. To make the check, he selects a section of the stream that is uniform in width and depth and stakes off a convenient length of it. Then he measures the depth of the stream in 6 or 7 measurements across it to arrive at an average depth. A chip is then dropped in the water at the upstream stake and is timed until it reaches the lower stake. From these figures the volume of water flowing in the stream can be calculated. For example: 20 feet of stream is measured and staked. The average width of the stream is 10 feet and the average depth is 2 feet. The cross section of the stream is then figured at 20 square feet. A chip floated down the stream takes 10 seconds to travel the 20 feet between the stakes. The water, then, is traveling at 2 feet per second, and the volume of flow is 40 cubic feet per second. To convert cubic feet per second into gallons multiply by the conversion factor 7.5, roughly the number of gallons in a cubic foot of water. This gives the working knowledge needed—the stream flows 300 gallons per second. To reduce it to a formula you can say: width in feet times average depth in feet times velocity in feet per second equals cubic feet per second; cubic feet per second times 7.5 (7.48 if you want to be absolutely correct) equals gallons per second.

In the humid States there are about 150 sizable streams running the year around which are large enough to irrigate the 50 million acres bordering them. At the present time less than a million acres of this land is irrigated.

The farmer who uses a well as the source of water has fewer guides to go by in figuring his water supply. He is not, however, completely in the dark. He can

write to his State water resources board or the State water division, as it is called in some States, and to the State office of the Ground Water Division of the United States Geological Survey, giving them the exact location of his farm and the amount of water he hopes to get from the well. These offices keep careful records of all water findings in the State and map the underground reservoirs. They can't always promise the farmer that he will surely find water at any particular spot or depth, but they can tell him what the findings in his area have been and they know when no ground water exists. They also know whether the underground water in his area is usable for irrigation or is contaminated with minerals. Other sources of information are industries in the area which are pumping ground water, other farmers, and, of course, the well drillers who are working in the neighborhood. With all the information lined up, it is still safest to drill a test well before beginning the expensive job of boring out the big 12- to 42-inch hole that will be necessary to supply sufficient water for irrigation.

On a farm which has neither stream nor well possibilities, a farm pond can sometimes provide the necessary water for irrigation. Each year as much rainwater runs off an acre of ground as stays on it; your job, trap it. In some States the water that can be collected from 4 acres is enough to irrigate 1 acre. An irrigation pond, however, is a far cry from a stock watering pond. "Most farmers, I find, tend to underestimate the amount of water it will take to operate an irrigation system," Virgil Overholt, one of the country's leading pond engineers, said the other day. "An irrigation pond should be large enough to hold all the water needed during the season when it is at pool stage. We can count on rain to supply enough water to take care of pond losses due to seepage and evaporation, but we've found that it isn't safe to count on the rain refilling the pond during the summer.

"In States with 35 to 40 inches rainfall," Overholt continued, "a farmer should plan to store a minimum of 5 acre-inches of water for each acre he plans to irrigate. If he plans to do a lot of pasture irrigation, he should up that figure." An acre-foot is the amount of water it will take to cover 1 acre of land 1 foot deep; this, incidentally, is 325,850 gallons. If a farmer plans to put 5 inches of water on 50 acres of crop during the season, he will need a pond which holds 250 acre-inches of water or 21 acre-feet. Such a pond could be one which is 13 feet at its deepest point and covers 5 acres. In most ponds the average depth can be figured at one-third the depth at the deepest point—this is a little on the generous side, but figuring it at one-half the deepest point is too skimpy.

The farmer who already has a pond and wants to know how many acres he can irrigate, reverses the process. The surface area is measured, keeping in mind that there are 43,560 square feet in an acre, and the depth is taken at the deepest point and divided by 3. Multiplying the area in acres by the average depth in feet will give the acre-feet.

In some States an irrigation pond reduces taxes. In Ohio, for example, the State will permit a farmer to deduct $40 from the assessed valuation of his farm for each acre-foot of water in the pond up to 40 percent of the valuation. The pond must have been approved, either before or after it was built, by the Division of Water. Few other water laws are on the books in the humid areas, but almost every midwest State legislature is planning laws which will make it necessary for a farmer to petition a State water control board for use of surface or underground water for irrigation.

EQUIPMENT

The old ditch and furrow method of irrigation is still occasionally used to supplement the rain in the humid part of the country, but it is getting to be as rare as a wet August. Today, almost all supplemental water is put on the crops with portable sprinkler systems. These systems are composed of a pump and a motor to run it, lightweight aluminum pipe with couplers to carry the water to the field, and coupled pipe with sprinkler heads which is moved from setting to setting down the field to give full coverage.

The kind of pump will depend on the water supply. A well which requires the pump to lift the water more than 15 feet before pushing it into the pipe will call for a turbine pump; if the pump can be set near the water level where most of the work will be pushing the water rather than lifting it, a centrifugal pump will be best. The motor to operate the pump can be either an electric motor, a gasoline or LP gas engine, or a diesel. Where electric power is cheap and where the pump is to be stationary, the electric motor has the advantage of easy operation—often by remote control—very low upkeep, and maximum efficiency. One of the drawbacks of an electric motor is that many electric companies charge a minimum fee for every month of the year when they put in the power lines for the

motor which, of course, jumps the cost of operation. Where gasoline or diesel engines are used they are often connected to the pump with a direct drive and the whole unit mounted on wheels to make it possible to move them from one water source to another. Most irrigation men figure that the cost of a rugged diesel is not justified unless there are to be at least 1,000 hours of pumping for the season.

Some farmers are powering their pumps with the power takeoff of the tractor, but since irrigation usually calls for all-day pumping and often everyday pumping, this is tying up a tractor to do the work of an industrial engine, which costs less.

The size and horsepower of the pumping unit should be closely geared to the amount of water to be pushed through the lines. This is one case where overdoing it just to be on the safe side doesn't pay off. An engine and pump which are too small for the job can be an awful pain in the pocketbook, but a pumping unit that is way too big is like using a dray horse to pull a sulky.

The light but very strong aluminum pipe that is being manufactured today makes the oldtime irrigators, who remember the galvanized iron pipe, say, "Boy, you should have been with us when it was rough. In the old days it used to take two of us to wrestle around a section of main line—now we send a high-school kid out and he'll pick up two sections at a time without uncoupling them." The weight of the pipe without the fittings runs from 7 pounds for a 20-foot section of 2-inch pipe to 27 pounds for 6-inch pipe. Pipe comes in 2-inch, 2½-inch, and at 1-inch jumps from 3 to 10 inches in diameter. The usual lengths are 20, 30, and 40 feet.

Almost all the pipe in use today is manufactured either by the Aluminum Co. of America or Reynolds Metals Co., though at least two other companies have announced their intention of getting into this field. The couplings, valves, and sprinkler-head attachments are manufactured by a number of different companies and a farmer would do well to see several of them to find the one he feels is most convenient for him to operate. Fittings are the key to the easy operation of a portable system. The couplings are designed for quick, one-man fastening with a rubber seal to prevent leaks, but with sufficient play so that the pipe can follow the contour of the land.

The sprinklers themselves turn slowly, either a full turn or a half circle, and usually spray two jets of water over the crop. They range in size from small models which throw about 2 gallons a minute to jumbo types which shoot some 600 gallons a minute over an area 400 feet in diameter. The type of sprinkler to use will depend on the crop, the soil conditions, area of coverage, wind, time of coverage, available labor, and certainly on the type of pump and size of pipe that is used.

ENGINEERING

You can't go out and buy an irrigation system like you can a tractor. The average farmer cannot hope to do his own engineering. He can get some help from his State extension people, but most of them will tell him frankly that his best source of help in engineering a system comes from the distributors who sell complete systems. These companies have been hiring trained people away from the colleges and training their own men to fill the growing demand of the farmers. They offer their services free as part of the cost of selling equipment and if a farmer doesn't take advantage of the service he just isn't getting his money's worth.

The Sprinkler Irrigation Association says, "When an irrigation system is planned by a dealer, he assumes full responsibility for the proper design of the system and should issue a warranty stating the performance expected for water-application rate, capacity, and the rate of coverage for a specific area serving specific crops. Where the purchaser buys the system piecemeal, he absolves all dealers of responsibility for the performance of the system as a unit."

A farmer who is in the market for an irrigation system would do well to get in touch with the various dealers in his area and let them show him plans and bids on the project. If he doesn't happen to know who the dealers are he can find out by writing to the Sprinkler Irrigation Association, 1028 Connecticut Avenue NW., Washington 6, D. C., or the Aluminum Co. of America, 1120 Alcoa Building, Pittsburgh 19, Pa., or to the irrigation market manager, Reynolds Metals Co., 2500 South Third Street, Louisville 1, Ky. Since these two companies manufacture practically all the irrigation pipe in use today they keep a list of irrigation-equipment dealers in all parts of the country.

The irrigation engineer usually follows this procedure in assembling the facts and setting up the system:

1. The water source is checked to make sure that there is enough water during the season to operate the system. As a rule, the engineer will take no responsi-

bility for well drilling or pond building though he will be a good source of information about these matters.

2. Aerial photographs are consulted and a map of the farm is made showing the fields to be irrigated, the source of the water, and the slope of the land. This last item is necessary in figuring the amount of pressure to push the water to the fields and the amount of water that can be applied without runoff.

3. The crops to be irrigated are then considered. Each crop has its own water requirements and each affects the amount of water that can be applied without eroding the soil. Corn, for example, is usually watered at silking and at tasseling time with enough water to wet the soil to a depth of 24 inches in heavy to medium soils and to 36 inches in sandy soil. Tobacco is watered at transplanting and at topping time. Alfalfa is usually watered after each cutting and pasture is watered after it has been grazed down and the animals moved. A general rule is that most crops make their heaviest demands on soil moisture at fruiting time. The rate of water application will depend on the soil type, but a cultivated crop like corn can take only about half the water that a cover crop like alfalfa can absorb on the same soil.

4. The soil type is studied to determine the amount of water that can be safely applied. This may range from a maximum of 2 inches an hour on well drained sandy loam soil with a cover crop to two-tenths of an inch on poorly drained, heavy textured soil without cover. The amount of water a particular soil will absorb must be known to prevent erosion and waste from runoff.

5. The distances to be traveled by the main line to the fields and by the lateral lines with their sprinklers across the fields are then measured.

6. The direction of the prevailing wind and its usual velocity is then determined. Since the water is spread through the air, the wind will affect the pattern of the spray. The engineer will try to design his system so that the wind crosses the laterals, and space his laterals to take care of the change in pattern.

With this information, the engineer is ready to get out his slide rule and charts and start doing some careful paper work. He will figure the size of the sprinklers to use, the amount of water they will put out in gallons per minute, and the pattern of the water they throw. Then he will work out the spacing of the sprinklers along the lateral line to give at least a 50 percent overlap. He then measures off the distance the lateral line may be moved at each setting and still give a 40 percent overlap of water between lines, so that all parts of the field are covered. To make these findings he will have had to figure the nozzle pressure and match it with the proper sprinkler equipment. At this point he will be about ready to sit back, resharpen his pencil, and take a deep breath before launching into the more complex part of the job.

Since the price of pipe goes up rapidly as the diameter increases, he will determine the smallest size for the main line and laterals which will do the job. Here he runs head on into the problem of friction. The smaller the pipe the greater the friction and as the friction of the water against the pipe goes up it takes a bigger pump and more horsepower to push the water through. He will consult many a chart that is so crisscrossed with reference lines and vectors that it looks more like material for a plaid shirt than an engineering document, before he comes up with the answer that will give the least expensive balance between pipe size and pump capacity.

In recommending the pump and the power unit to operate it, the engineer will have to take into consideration not only pipe size but amount of water to be pumped each minute, the pressure to be maintained at the sprinkler heads, the lift of the water from the well, and the extra pressure it will take to push the water to the fields if they are at a higher elevation than the water supply.

Since the pump and its power unit may run to a third the cost of the whole system, the recommendation of a pump is a matter that can stand considerable thought, if not downright fasting and prayer. Fortunately, the pump manufacturers issue accurate data sheets on each piece of equipment detailing its capacity and efficiency at different pressure outputs and at different power settings.

Before his job is done, the engineer will set up an operation schedule for the system, giving the amount of acreage to be covered at each setting of the laterals, the amount of water to be applied at a setting, the length of time each setting should be allowed to run, and the schedule for covering the crop. He will also be in a position to work out the cost of operation, which will depend on the size of the power unit needed and the labor costs involved in moving laterals.

OPERATING THE SYSTEM

Getting the most out of an irrigation system is a matter of adjusting its use to the soil and to the crops grown. Each type of soil has a different water holding capacity, a different rate at which it will absorb water, and a different stage at which water is available to plants. Heavy, clay soils, for example, take in water slowly and hold onto it tenaciously. Plants reach their wilting point—the point at which there is no more soil moisture available to them—while the clay soil still contains 35 percent moisture. Light, sandy soil, on the other hand, takes in moisture freely and gives it up easily. Sandy soil will hold but 20 percent moisture when plants reach the wilting point.

The object of irrigation is to keep the soil moisture somewhere between the wilting point and the saturation point. To accomplish this requires a nice judgement of the soil moisture and the amount of water to apply. Electrical moisture testing devices such as the one designed by John Bouyoucos, professor at the Michigan Agricultural Experiment Station, Lansing, Mich., can be used to give an accurate soil-moisture reading. An experienced farmer, however, will be able to make a fairly accurate judgment by the look and feel of the soil.

A rough test suggested by C. H. Diebold, of the Soil Conservation Service, is to spade up a bit of earth from 12 to 14 inches below the surface and try to squeeze it into a ball—squeezing it about as hard as you would on a hard-milking cow. If the soil won't form a ball after 3 or 4 squeezes, it has less than a fourth as much readily available moisture as it would have at field capacity and should be irrigated. If a ball is formed, the soil has at least one-fourth capacity. Now toss the ball about a foot into the air and catch it. If it breaks and crumbles after five such tosses, the soil contains from one-fourth to one-half the readily available moisture it will have at field capacity—this is the best time to irrigate. If the ball holds firmly together after five tosses, there is more than one-half readily available moisture and you won't have to irrigate for a while.

The danger signs that too much water is being put on the land are puddling and run-off.

Tied in with irrigation is the problem of drainage. One agronomist has said, "If a field doesn't have good drainage you shouldn't irrigate. I knew a potato raiser who was irrigating a crop on poorly drained land—too poor for potatoes in the first place. A couple of days after he had given the field a good slug of water he got a nice rain and lost the whole crop. If drainage is a problem on the land, I'd say that the farmer should solve this problem first before he starts thinking of irrigation."

Another point that most old hands at irrigation bring up is the matter of increasing the fertilizer application. On most farms water has limited the amount of a crop that can be grown and the farmer has applied the amount of fertilizer the thirsty crop could use. Removing this water limitation, he will have to think in terms of increasing his fertilizer application by about 50 to 100 percent. Some of this fertilizer can be applied through the irrigation system itself, using one of the new liquid fertilizers developed for this purpose. The plant foods are measured exactly for the area covered by the laterals and fed into the system through a special intake attachment at the water supply. Fertilizer is usually put through the pipes at the beginning of a setting so that the water will have a chance to wash the corrosive solution from the pump, pipes and sprinklers before shutting down for a move.

COSTS

Since each system must be tailored to fit the farm it serves, the cost of equipment varies rather widely, running from $45 to $200 an acre. At first glance this may seem like a confusing spread, but let's look at the problem as one New York dairyman faced it. He had one 20 acre rectangular field 1,320 feet long by 660 feet wide with a good stream running down the long side, an ideal set-up for irrigating a pasture to use in mid summer to take the place of the silage he had been feeding when his pastures dried up. The stream, in effect, was his main line and all he needed was a pumping unit, a short, 60-foot section of main line to reach the field, and one 660-foot lateral with 11 sprinklers on it. Each sprinkler covered a strip of land 60 feet wide and poured on 2 inches of water in 5 hours. When one setting had been watered he moved pump and line 60 feet down the stream and continued watering. He could do the whole job with a 165 gallon per minute capacity pump and a 12 horsepower engine-pump unit which cost in the neighborhood of $550. His pipe, sprinklers, and fittings cost $1,257.

This same farmer also figured his irrigation costs for a 20 acre back field that lay some 400 yards from the stream and at a 100 foot higher elevation. His first

item of added cost was for 1,840 feet of main line. To push the water up to this field he had to use a 36 horsepower pumping unit which cost $850 and his pipe bill would have been $3,388. "I figure that I could even irrigate oats profitably on the lower field," he said, "but if I were to put in a system to water the back patch only a real high return truck crop would make it worth while."

Tom Pottenger, mentioned earlier, was able to hit close to the lowest per acre price when he bought his system. He had two big points in his favor. In the first place he has the river at one end of the farm and a shallow, high producing well at the other, which cuts down on the length of main line he needs to reach any part of the area. His second big advantage is that in raising sweet corn for the market he starts planting as early in April as the weather permits and continues planting at weekly intervals until July. With such a system he has part of his crop harvested before the last planting has sent up its first leaves. So only about 40 acres of the crop is making peak demands on his irrigation system at any one time.

Late last fall, after living through a drought which cut his corn yield by 40 percent, Pottenger called in an agronomist and an irrigation engineer from Ohio State University to advise him on the possibilities of irrigating the farm. They found that the sandy, well drained soil and abundant water supply made the place practically ideal for supplemental irrigation. He next drilled a test well at the proposed site of the irrigation well and found plenty of water in the thick gravel beds which lie from 15 to 50 feet below his land. By this time he was ready to talk business, and invited several distributers of irrigation equipment to send their engineers to the farm, plan the operation, and make a bid on the job.

With each engineer he went over the whole problem from water supply to the time and manpower it takes to move a lateral (in his case they all agreed it would take 2 high-school boys about 45 minutes to move a 1,400-foot lateral to a new setting). He compared their equipment and asked them every question that a careful farmer could dream up.

In the end, he wound up with an intensive course in irrigation engineering from some of the top men in the field and an order for a system which consisted of a mobile pump powered by a 50-horsepower industrial gasoline engine which can handily turn out the 500 gallons a minute needed; 1,060 feet of 6-inch main line; 480 feet of 5-inch line which can be used at one point to extend the main line and at another to lengthen the laterals; 1,380 feet of 4-inch lateral line; and 24 sprinkler heads along with the reducers, adapters, tees, plugs, elbows, nipples, and other hardware needed to complete the system. He also wound up with a bill for $5,950.

"In normal years," Pottenger said, "We'll put an inch and a half of water on the corn twice, at silking and tasseling time. If we run into a dry spell like last year we'll water every 8 days after any 1-inch rain. The sprinklers will be set at 60-foot intervals along the line and we'll move the line 80 feet down the main for each setting. Each setting will water a little over an acre and a half, so, with 3 moves a day, we should be able to put water on 5 acres a day without having to go into night irrigation."

RETURNS

"We expect that in normal years the irrigation system will pay for itself in 3 or 4 seasons," Pottenger continued. "In the first place we believe we will be able to average twelve to fourteen hundred dozen ears to the acre with irrigation where, without it, we have been shooting for a thousand dozen, like field corn men shoot at a hundred bushels to the acre. Then we should be able to get on the market a week earlier, which means a lot when you realize that corn is selling for about twice as much then as it is later in the season. And finally, we plan to follow the corn with summer and fall planted alfalfa and give it enough water so that we'll be able to take 5 or 6 tons an acre off it the next year. Of course we may not get the $40 a ton they were paying for hay out our way last winter, but there's always been a pretty good market for it and we may increase the number of feeder lambs we handle and feed it out ourselves."

Pottenger's hope to increase his corn yield by 20 to 30 percent seems well within the realm of possibility when compared to the actual increase due to irrigation made on the J. Alvin Hardin farm near Knightstown, Ind. Hardin, who is a banker, works closely with his tenant, John Lansinger, in keeping careful records on his irrigation project. In 1952, which was a dry year in that area, he made 127 to 137 bushels to the acre on 16 acres of irrigated field corn as compared to 42 bushels on unirrigated land. To make this yield he put on 5.8 inches of water and burned up 375 gallons of gasoline to operate the pump.

"This last year," Hardin said, "we increased our irrigated acreage to 22 acres of corn and 8 acres of pasture. We put on around 2 inches of water at tasseling time, 2½ inches 2 weeks later, and another 2 inches during the August dry spell. We were also trying out a number of different hybrids and found that our yields ranged from 166 bushels to the acre down to 134. This was a pretty good corn year around here. Our nonirrigated corn ran 102 bushels. The point I want to make is that even during good years irrigation paid us at the rate of about 50 bushels to the acre.

"We also irrigated 8 acres of alfalfa, giving it 2 inches of water after the first cutting and 2½ inches a couple of weeks later. We got 4 cuttings instead of the 3 on the unirrigated alfalfa with an increased yield of 74 percent after the first cutting.

"In figuring our costs we find that we pumped about 6½ inches of water on each acre for a total of over 5 million gallons. The cost of labor, gasoline, and depreciation—I depreciate equipment at the rate of 10 percent a year; that way I get some of it back in taxes—ran right around $30 an acre or around $4.60 for each inch of water. When you compare the results we've had in a good year with what we've had in the bad years, all I can say is that as a banker I don't know of a better way to get that much return on your investment."

THE UNIVERSITY OF WYOMING,
Laramie, Wyo., May 25, 1953.

Senator JAMES O. EASTLAND,
Senate Office Building, Washington, D. C.

DEAR JIM: Thank you for your letter of May 18. I appreciate very much your detailed explanation of your interest in irrigation in Mississippi and other southern States. As you know, in the West we look to irrigation and conservation as important aspects of our economic well being.

For many years I have headed the committee on irrigated agriculture and water resources of the Association of Land-Grant Colleges and Universities. I am sure our committee could endorse the bill in which you are interested. If there is any particular work you would like to have us do in respect to congressional contacts, please let me know.

I expect to be in Washington before long, and I hope to have an opportunity to see you then.

Best wishes.

Sincerely yours,

DUKE.

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